FINAL REPORT

AUTOMATIC SUBMERGED ARC WELDING WITH METAL POWER ADDITIONS TO INCREASE PRODUCTIVITY AND MAINTAIN QUALITY

JUNE 1986

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FOREWORD

The purpose of this report is to present the results of a research and development project which was initiated by the members of the Ship Production (SP) Committee of the Society of Naval Architects and Marine Engineers (SNAME) and financed largely by the U. S. Maritime Administration (MarAd), the U. S. Navy and Newport News Shipbuilding (NNS). The focus of this project was directed toward evaluation, testing, and qualification of metal powder additions to automatic submerged arc welding for shipyard use.

Mr. B. C. Howser of NNS was the Chairman of the SP-7 Welding Panel and Mr. M. I. Tanner, also of NNS, was the Program Manager. Mr. R. W. Heid, NNS, was the Project Manager, and Messrs. P. D. Thomas and L. A. Craig of NNS were the Principal Investigators.

Special acknowledgement is extended to the members of Welding Panel SP-7 of the SNAME Ship Production Committee who served as technical advisors in the preparation of inquiries and evaluation of subcontract proposals, and to Mr. M. I. Tanner for making possible the report compilation.

Summary

This paper presents the results of an SP-7 Welding Panel research and development project recently completed by Newport News Shipbuilding. The focus of this project was directed toward the evaluation, testing, and qualification of Automatic Submerged Arc Welding (SAW-AU) with metal powder additions for shipyard use.

Metal powder additions provide an increase in deposition rate (pounds of weld metal deposited per hour) without an accompanying increase in heat input (kilojoules per inch), and also provides a finer heat affected zone grain structure and narrower heat affected zone than conventional SAW-AU. Higher deposition rates, when obtained by higher heat input, can degrade the mechanical properties of the weld and adjacent base metal. Metal powder additions can produce quality welds with lower actual heat input joining either mild steel or quenched and tenpered steel (HY-80), in substantially reduced time.

The project consisted of both carbon steel and HY-80 test weldments using one-sided, double-bevel, and fillet joint designs at several heat inputs and powder-to-wire ratios. Nondestructive testing included magnetic particle, ultrasonic, and radiographic inspections. Destructive testing included tensiles, Charpy V-retch impacts, dynamic tear impacts, side bends, hardness surveys, and explosion testing.

It is concluded that controlled metal powder additions are indeed a production concept that can reduce shipbuilding costs through increased deposition rates and reduced constables costs while, at the same time, maintaining or improving quality.

Purpose:

The purpose of this project was to develop techniques, test, and qualify the use of Automatic Submerged Arc welding with metal powder additions to join either carbon steel or HY-80 plate.

Background:

Automatic Submerged Arc Welding (SAW-AU) has a long and proven track record in the shipbuilding industry. This “under powder” or “smothered” are process was developed by the National Tube Company and patented by Robinoff in 1930. The patent was later sold to Linde Air Products Company who renamed the process “Unionmelt” welding. SAW-AU was used extensively during the defense buildup in the late 1930’s and early 1940’s in both shipyards and ordnance factories. It is a high deposition welding process that remains stable at amperages four or more times greater than the familiar manually performed Shielded Metal Arc Welding (SMAW). The American Welding Society (AWS), in AWS A3.0 "Welding Terms and Definitions” defines submerged arc welding as:

> An are welding process that produces coalescence of metals by heating them with an arc or arcs between a bare metal electrode or electrodes and the workplaces. The arc and molten metal are shielded by a blanket of granular fusible material on the workpieces. Pressure is not used, and filler metal is obtained from the electrode and sometimes from a supplemental source (welding rod, flux, or metal granules).

SAW-AU does not require burdensome welding shields, earmuffs, or constant operator torch manipulation like manual or semi-automatic welding processes. The physical size of the equipment usually does not allow “tight quarters” welding nor much out-of-position work. It is ideally suited for long, thick section welding in the flat or horizontal position with reduced double-bevel joint angles as low as 45°, one-sided joint angles as low as 20°, and square butts on thin materials. This combination of high deposition, operator appeal, and suitability for large weldments make SAW-AU a very effective process and an attractive first choice for shipyard weldments.

To increase the deposition rate[1/] of conventional single-wire SAW-AU, most efforts have centered around increasing the total. heat input, [2/] either through the use of multiple electrodes or higher currents/lower travel speeds. The use of multiple electrodes/high heat input usually requires special joint designs with large root faces and larger included angles, as well

1/ Measured in pounds per hour (lbs/hr)

2/ Measured in kilojoules per inch (KJ/in) using the formula:

$$\text{Heat input} = \frac{\text{arc volts} \times \text{amps} \times 60}{\text{travel speed}}$$

as more restrictive fitting tolerances. These efforts give higher depositio rates with resultant liner mechanical properties. The lower mechanical properties are related to the microstructure in the heat affected base mater immediately adjacent to the weld fusion line (see Figure 1). The area betwe the weld fusion line and the point where the base metal is unchanged is know as the heat affected zone (HAZ). The base material in this HAZ is heated to different levels, with near-molten temperatures at the fusion line. As the weld is cooling, the HAZ is also cooling, with the metal near the fusion lin cooling more slowly. The overall width of the HAZ is directly related to th total coding rate. A slower cooling rate allows the grains to grow (or, fo HY-80, to change structure) and therefore the base metal grain structure adjacent to the fusion line will be coarse (or of an undesirable form). The coarse grains reduce ductility and toughness below acceptable levels.

The addition of controlled-chemistry metal powder just ahead of the SA flux (see Figure 2) can also be used as a method to increase deposition rates. Using a special system (see Figure 3), metal powder of compatible chemistry is metered into the joint at a specific rate. As the welding arc passes over, the powder-melts and becomes part of the weld puddle, producing significantly higher deposition rate without the use of additional electrica energy (i. e., lower total heat input). This method provides a finer HAZ gra structure, a narrower HAZ, and higher mechanical properties. It does not require special joint designs or stringent fitup tolerances, and the reduced number and large size of the beads will help reduce distortion. The use of metal powder additions a result in reduced consumables cost. The disadvantage of metal powder addition is that, unlike conventional SAW-AU, welding can only be performed in the flat position.

Task:

The original proposal for this project can be found in Appendix A. The primary objective was to qualify procedures for both carbon steel/HTS and HY- that meet military specifications (MIL-STD-248C) using SAW-AU with metal pow additions. The main function of the project was to determine working parameters, optimum powder-to-wire ratio, usable joint designs, and criticali of bead placement through nondestructive and destructive tests. Other areas study were to include: (1) storage and handling problem, (2) effect on productivity and quality, (3) consumables cost, (4) best powder addition equipment, and (5) the effect on distortion.

Plan:

The plan to accomplish the above task is shown below:

1. Research present information: Run the DIALOG “Weldasearch” program and provide that information.

2. Calculate joint volumes for typical joints and compare consumables cost estimates for HY-80.

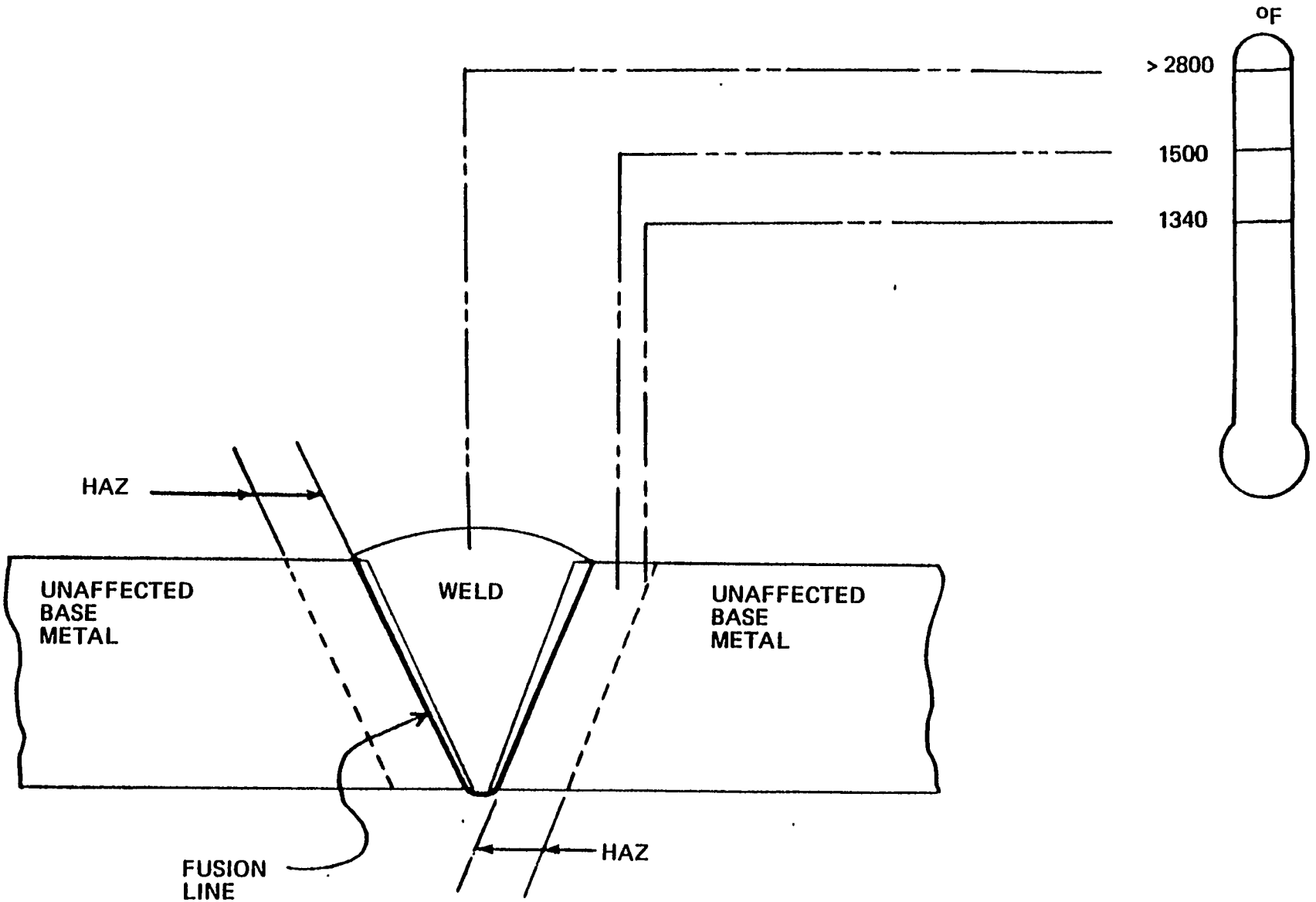

Figure 1
Peak Temperatures Across the Weld Zone

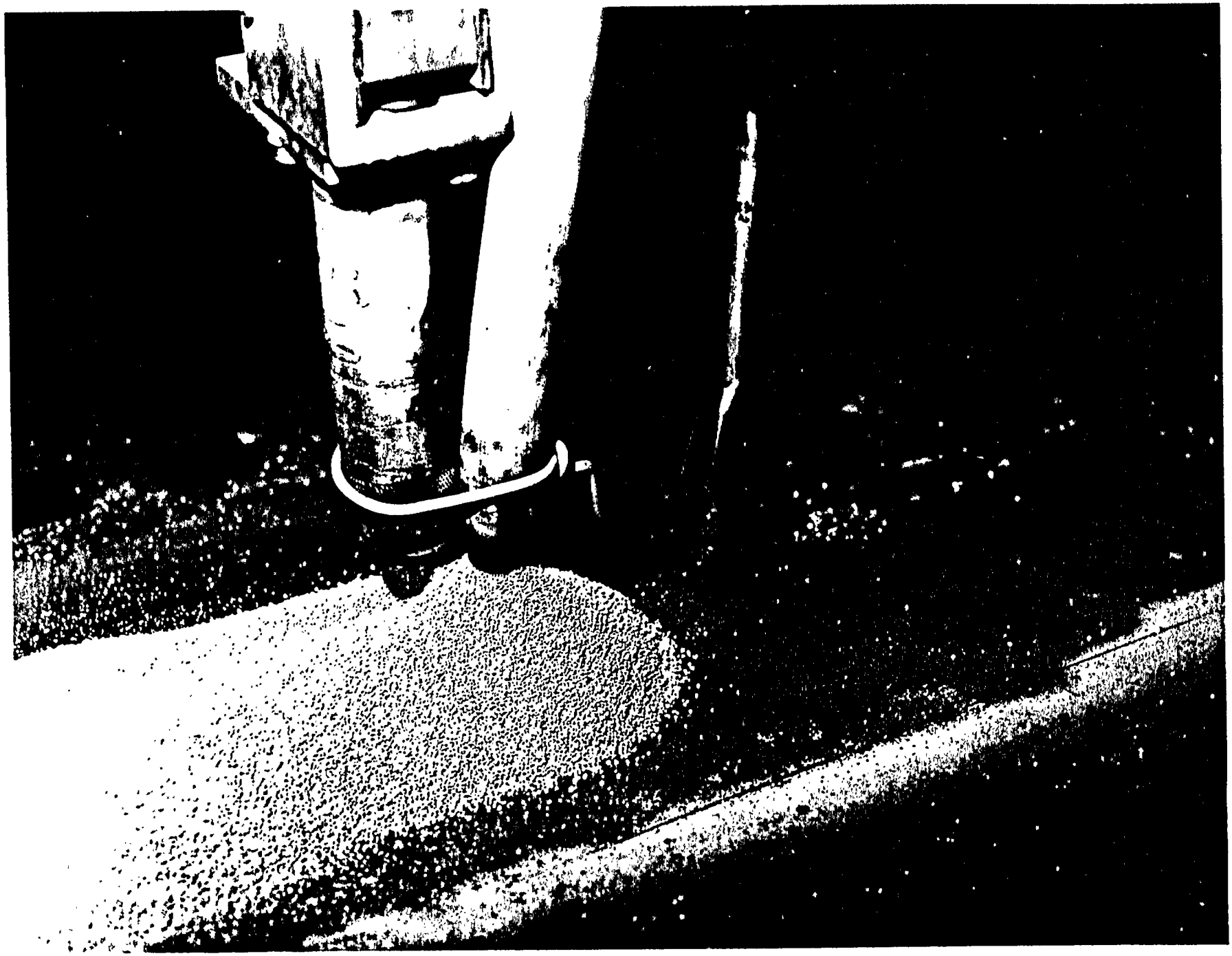

Figure 2
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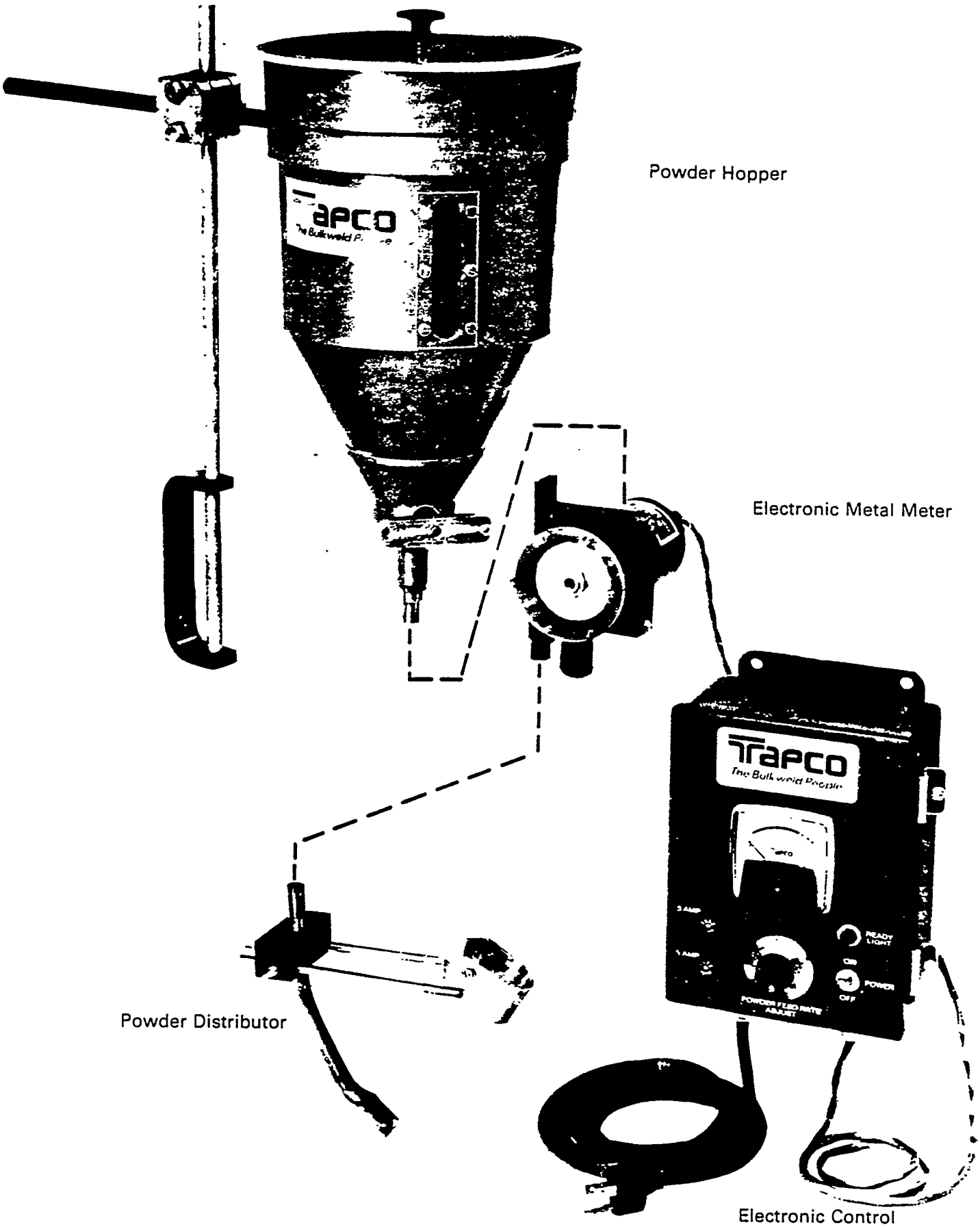


Figure 3
Metal Powder Dispensing System

3. Weld preliminary test assemblies to determine working parameters, optimum powder-to-wire ratio, and joint design requirements. Nondestructive testing and destructive testing to be performed and results to be provided.

4. Weld qualification joints on HY-80 using information from Item 3. Nondestructive and destructive testing (including explosion testing in accordance with MSL-SID-2149) to be performed. Results of testing to be provided.

5. Weld qualification joints on carbon steel using information from Item 3. Nondestructive and destructive testing to be performed and the results provided.

During the course of the project, it was determined that the original powder used for carbon steel weldments under Item 3 may not have been compatible with the welding electrode. As a result, a comparison of two powders for carbon steel was added to Item 5.

Equipment:

After investigating, only one commercially available metal powder dispensing system was found. Users of metal powder additions either used no metering system at all, or used the Tapco system. Throughout the project, the Tapco metal powder dispensing system was used with either a permanent side-beam SAW-AU installation or a portable track mounted SAW-AU carriage (the two most cammon methods in shipbuilding). Figure 4 shows the operator working with the side-beam equipment, and Figure 5 shows how the metal powder hopper, metal meter and powder tube were installed. Specific equipment used during the majority of this project is listed below:

Linde CM100 Side Beam Welding Station
Lincoln Idealarc DC1500 Power supply
Lincoln NA-3S controller
Tapco metal powder dispensing System
Electric strip heaters (for HY-80 only)
Arc time recorder
Scale (capable of reading 0-700 lbs ± 1 lb)
Scale (capable of reading O-1000 grams ± .01 gram)
Markal temperature crayons

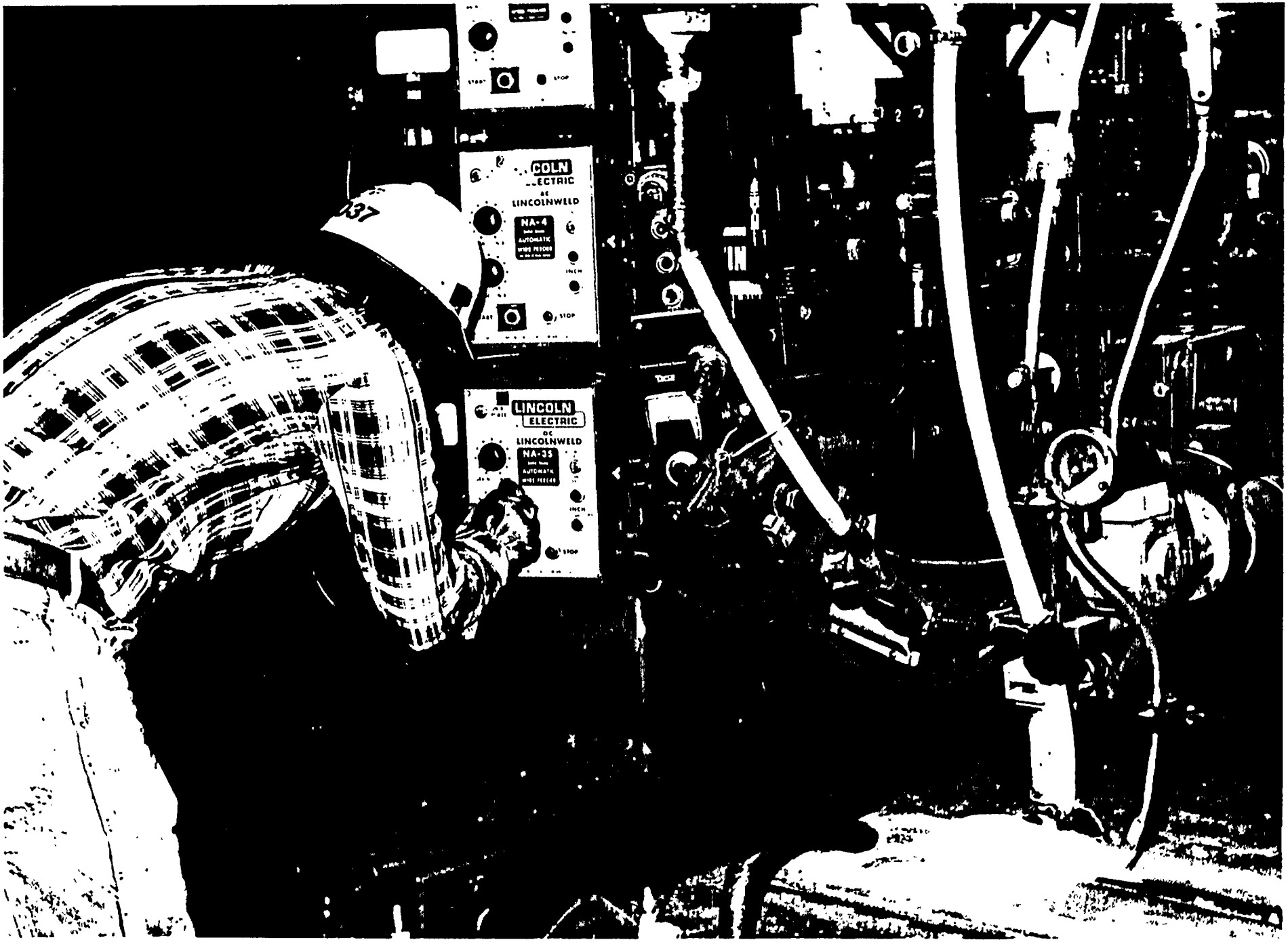


Figure 1
Technician Operating Side Beam SAW-AU with Metal Powder Additions

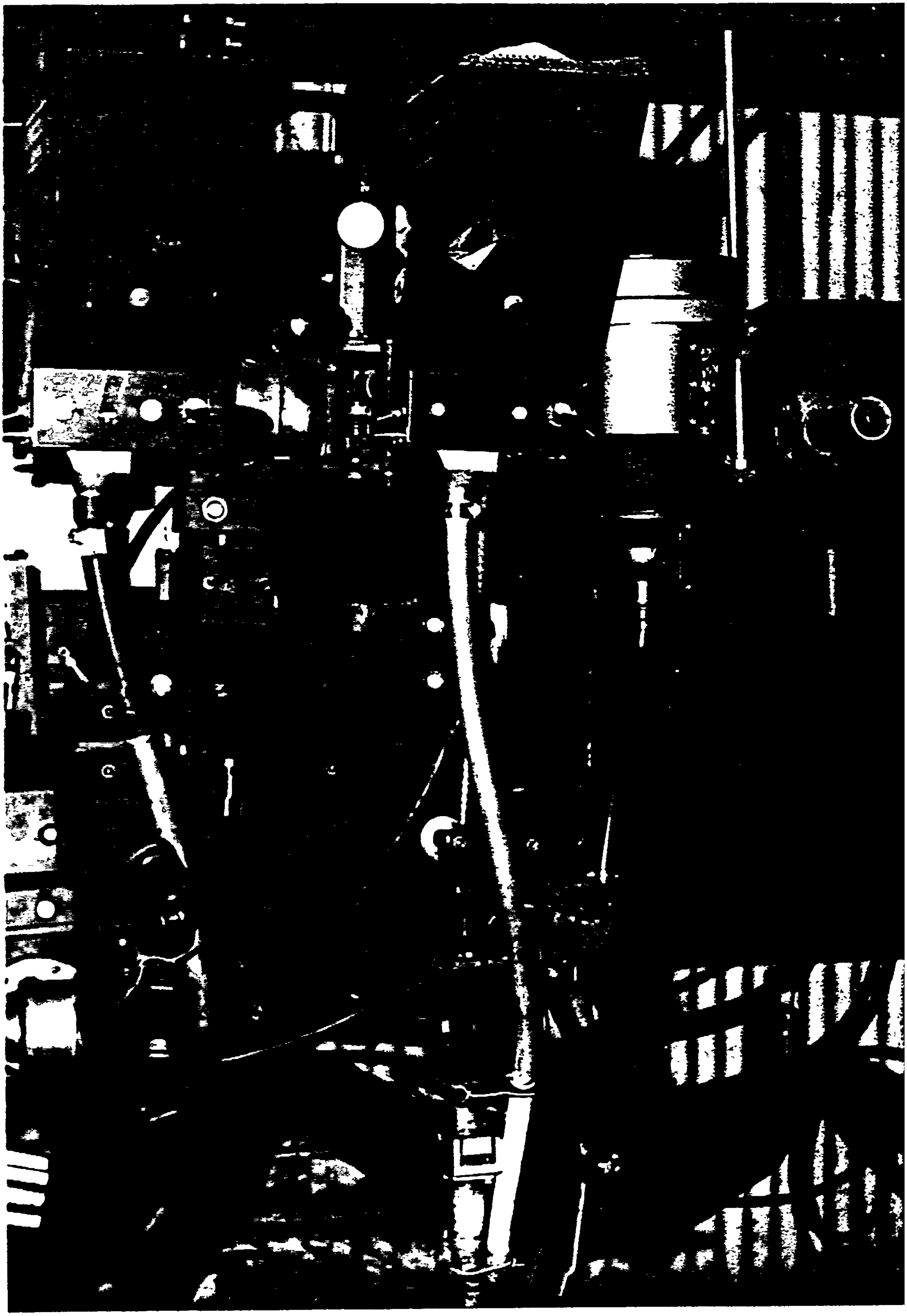


Figure 5

Steel wool (for arc initiation)
Lincoln Digital Wire Feed Speed Indicator

The same safety precautions used during normal SAW-AU operations were followed when adding metal powder.

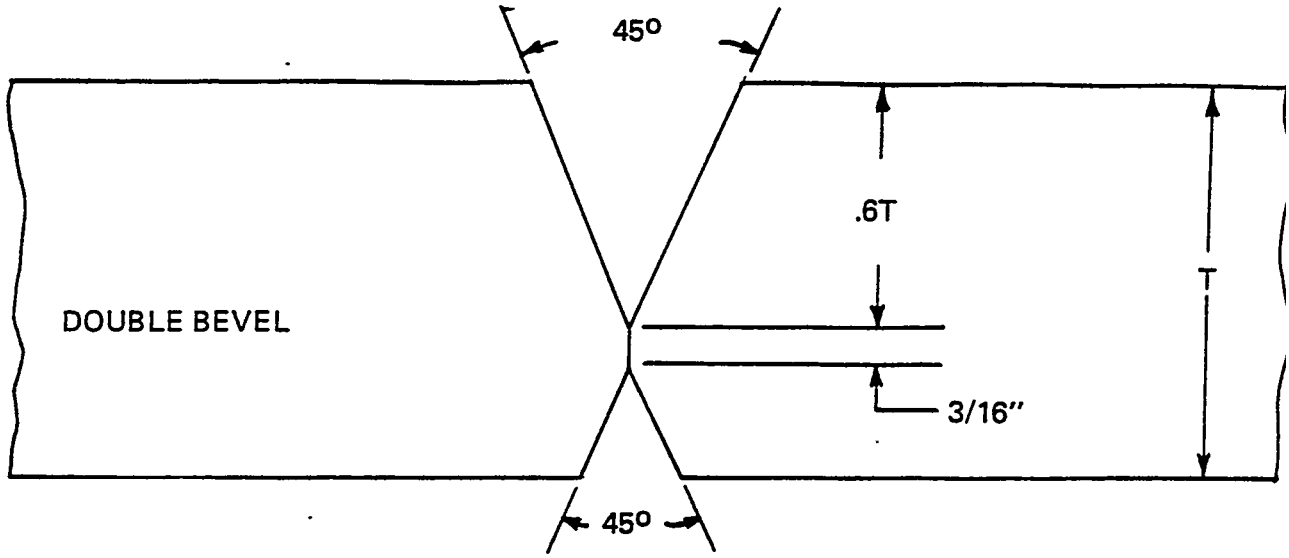
Method:

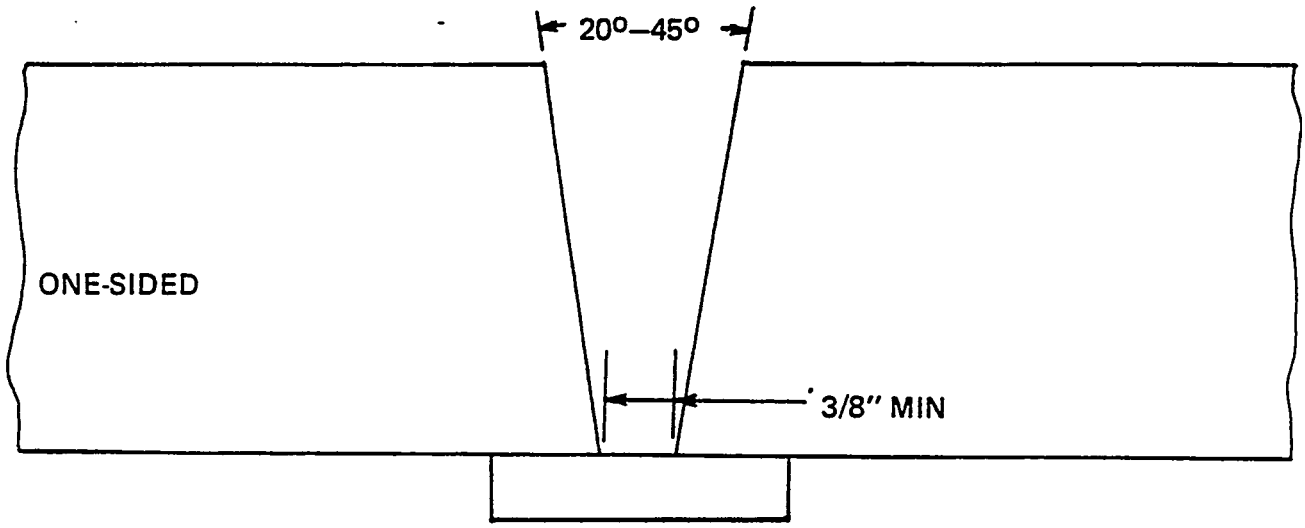
Initially, a thorough search of recent literature concerning metal powder additions to SAW-AU was Performed. This search included use of tHe DIALOG "Weldasearch" program to investigate a larger international data base. Calculations on typical one-sided and double-bevel joint volumes and constables costs for HY-80 were perfonmed. The constables costs reflect typical welding electrode, metal powder and flux costs and contain projections based on large-scale purchases of the metal powder.

All of the joints in this project were prepared by oxypropane cutting and grinding; run-on/run-off tabs were installed and the joints were tacked together. One-sided joints were tacked to a 3/8" minimum thickness backing strap on the side oppsite the joint. Double-bevel and fillet joints were joined only by the run-on/run-off tabs, with no tacks in the joint. In sane cases, double-bevel joints used 3M backing tape SJ8073 to avoid burn-through during root pass welding. All three joint designs are shown in Figure 6.

Base materials were Carbon Steel (CS) of MIL-S-22698, High Tensile Steel (HTS) of MIL-S-24113, and Quenched and Tempered Steel (HY-80) of MIL-S-16216. For the purposes of MIL-STD-248 procedure qualification, carbon steel and HIS are classed under one general category (S-1 of Table 1, MIL-STD-248) and qualify each other. All welding was performed with direct current, reverse polarity in the flat (1G and 1F) position. For carbon steel/HTS joints, welding was performed using 5/32" diameter MIL-A1 electrode of MIL-E-18193 (Linde 80) and MIL-F2 flux of MIL-F-18251 (Lincoln 780). For HY-80 joints, welding was performed with 1/8" diameter MIL-100S-1 electrode of MIL-E-23765 (Lincoln IA-100, Linde 95) and MIL-100S-lF flux of MIL-E-23765 (Oerlikon OP121TT, Lincoln 880M). HY-80 joints were welded using 150°F minimun and 300"F maximun preheat and interpass controls. MLL-1OOS-1F flux was heatd to 250°F minimun prior to use and remained warm to the touch while welding. Three different heat inputs were used for HY-80 welds (55, 85 and 110 KJ/in). Parameter levels across the applicable range were used for carbon steel welds.

The three metal powders used during the project were Oerlikon's EL-12, M-13K, and M-2. When powder was added to a weld joint, it was metered at a specific rate, i.e. a certain powder-to-wire ratio. Several different powder-to-wire ratios ranging from .50:1 to 1.5:1 were tried. The method of constructing graphs to establish the correct dial setting for a certain powder-to-wire ratio is described below:





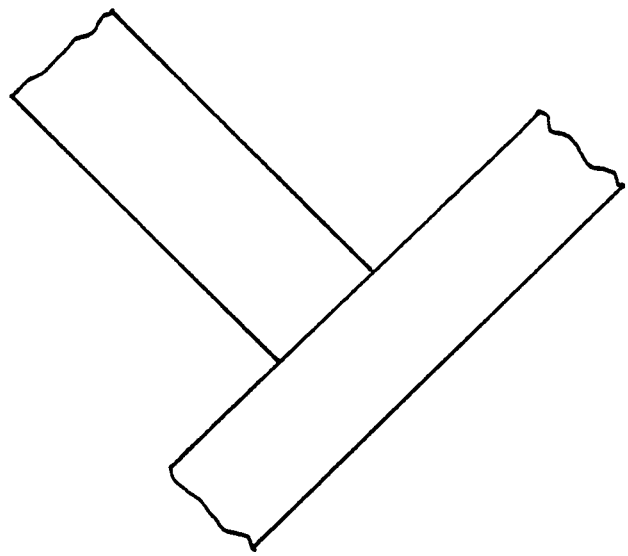


Figure 6
Joint Designs Used for Evaluation

1. Beads were run on flat plate using the correct diameter electrode across the parameter range. The wire feed speed (WFS) was recorded (in inches per minute) for each amperage point. The deposition rate (in pounds per hour) was calculated using the formula:

WFS (in/min) x wire CSA (in^2) x wire density ($\#/in^3$) x 60 min/hr = Dep. Rate

simplifying:

WFS x wire $dimeter^2$ x 13.34 = Deposition Rate in lbs/hr.

A table and graph similar to that shown in Figure 7 was constructed for each wire diameter.

2. The powder deposition rate was detemined by running the dispensing system (with the correct powder) for one minute and weighing the output in grams . Three readings were taken for each dial. setting and averaged. This average was converted to pounds per hour (lbs/hr) of powder using the formula:

grams x (2.205×10^{-3}) x 60 = Powder Deposition Rate in lbs/hr.

Tables similar to those shown in Figure 8 were constructed for each powder.

The graph and table just mentioned were used together to find the correct dial setting for a particular amperage (or wire feed speed) and powder-to-wire ratio. An example is shown using the data in Figures 7 and 8:

Amperage	Wire Dia.	Calculated Wire Feed Speed	Deposition Rate
400 A	.125 in	56 ipm	11.7 lbs/hr
450 A	.125 in	60 ipm	12.5 lbs/hr
500 A	.125 in	65 ipm	13.5 lbs/hr
550 A	.125 in	75 ipm	15.6 lbs/hr
600 A	.125 in	85 ipm	17.7 lbs/hr
650 A	.125 in	96 ipm	20.0 lbs/hr
700 A	.125 in	102 ipm	21.2 lbs/h.r
750 A	.125 in	109 ipm	22.7 lbs/hr
800 A	.125 in	120 ipm	25.0 lbs/hr

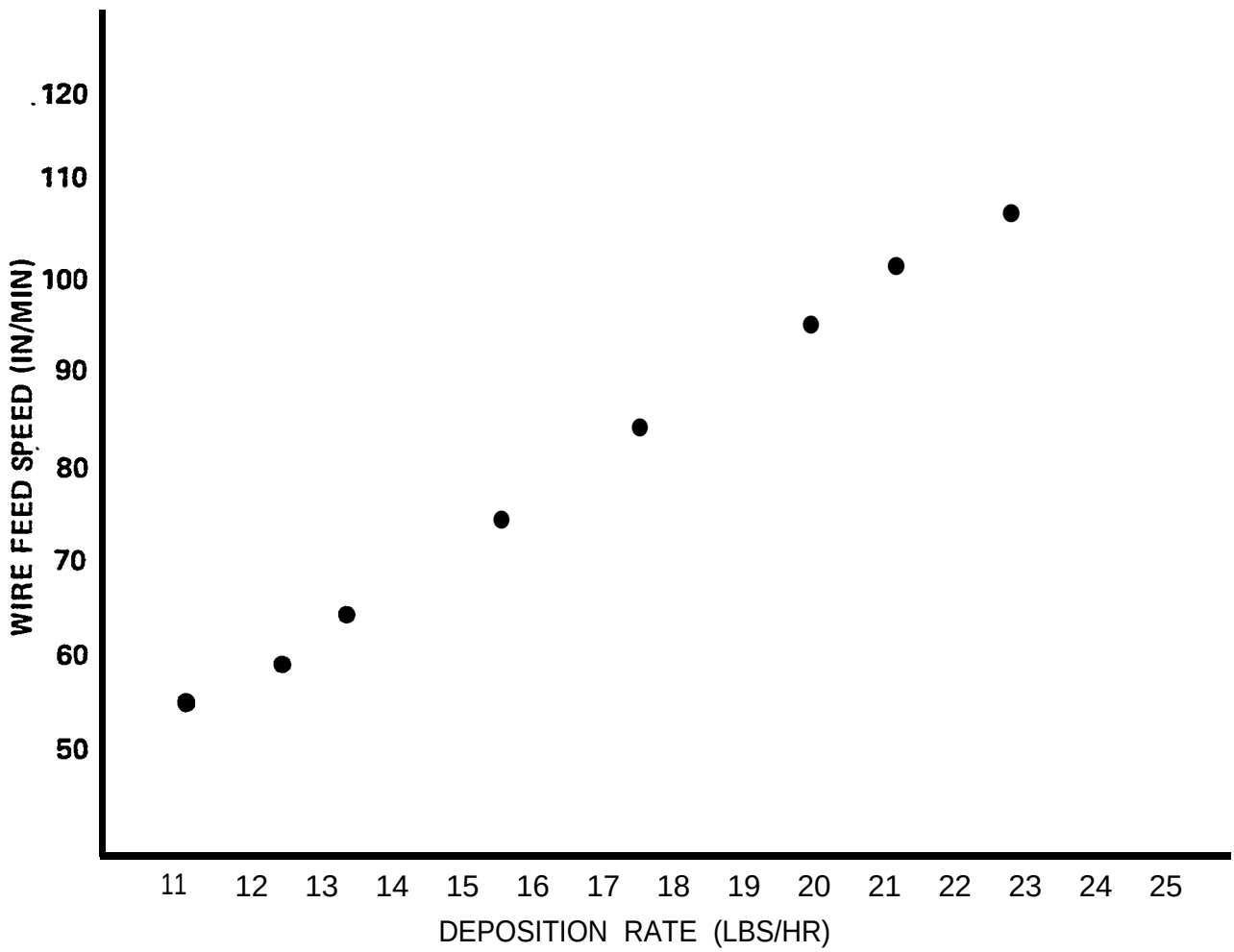


Figure 7
Sample 1/8″ Electrode Deposition Calculations

Dial Setting	M2 Power Weight in 1 Min	Average Powder Weight
5.0	94.6 gr	
5.0	92.5 gr	
5.0	93.1 gr	93.4 gr
7.5	141.4 gr	
7.5	142.3 gr	
7.5	142.5 gr	142.1 gr
10.0	187.2 gr	
10.0	187.9 gr	
10.0	189.1 gr	188.1 gr
12.5	226.0 gr	
12.5	226.1 gr	
12.5	226.6 gr	226.2 gr
15.0	254.1 gr	
15.0	252.7 gr	
15.0	253.7 gr	253.5 gr
17.5	279.5 gr	
17.5	281.4 gr	
17.5	277.8 gr	279.6 gr
20.0	299.6 gr	
20.0	298.8 gr	
20.0	299.4 gr	299.3 gr

Dial Setting	Powder Deposition Rate (lbs/hr)
5.0	12.6
7.5	18.6
10.0	25.2
12.5	30.0
15.0	33.6
17.5	37.2
20.0	39.6

Figure 8
Dial Settings vs. Powder Deposition Rates

EXAMPLE

Determine: Dial Setting for 1.25:1 at 500 amps using M2 powder and 1/8″ MIL-100S-1 electrode.

Solution:

1) Using the graph in Figure 5, determine the wire deposition rate (= 13.5 lbs/hr).
2) Determine required powder deposition rate (1.25 x 13.5 lbs/hr' = 16.875 lbs/hr).
3) Using Figure 6 and a simple ratio, determine the correct dial setting

$$\frac{7.5}{18.6} = \frac{x}{16.9} \quad ; \quad X = 6.8$$

In this case, the correct dial setting would be 6.8.

For many of the joints, an actual deposition rate was found by weighing the weldment (in pounds) at various stages and recording the arc time (in minutes). Double~bevel joints were weighed after fitup (W_1), after first side completion (W_2), after backgouging (W_3) and after completion (W_4). One-sided joints were weighed after fitup (W_1) and after completion (W_4). The deposition rates were calculated using these formulas:

(Doubl-bevel) $$\frac{(W_2 - W_1) + (W_4 - W_3)}{\text{arc time in minutes}} \times 60 = \text{Deposition Rate in lbs/hr}$$

(Single-bevel) $$\frac{(W_4 - W_1)}{\text{arc time in minutes}} \times 60 = \text{Deposition Rate in lbs/hr}$$

Nondestructive testing (NDT) included magnetic particle testing (MT) of backgouged surfaces and final weld faces, and radiography (RT) of completed welds. In sane cases ultrasonic testing (UI) of campleted welds was performed for information. All NDT was performed as outlined in MIL-STD-271 D in order to satisfy the procedure qualification requirements of MIL-STD-248C.

Mechanical testing included cambinations of side bends, transverse tensiles, all weld metal tensiles, Charpy V-notch impacts (both weld metal and

across the HAZ), -and dynamic done in accordance with MIL-STD-248C Joints M729-38, 40 and 41 (HY-80) were explosion tested as specified in MIL-STD-2149.

Results :

The output from the DIALOG "Weldasearch" can be found in Appendix B. The joint volume calculations and consumables cost estimates for HY~80 materials can be found in Appendix C.

The welding data sheets for all campleted joints can be found in Appendix D. Table 1 gives a list of joint variations and actual. deposition rates, and was used in determining the optimum powder-to-wire ratio. Table 2 shows chemical analyses for the base and filler materials used on carbon steel/HTS joints, and Table 3 shows the same information for HY-80 joints. The NDT results are reported in Table 4 along with the acceptance criteria for each test. Mechanical test results from the side bends, transverse tensiles, and all weld metal tensiles are given in Table 5. Results from impact tests (CVN or DT) are reported in Table 6 and include test temperatures, individual values, and averaged values. Appendix E contais the final. report by Mare Island Naval Shipyard and pictures of the explosion testing for joints M729-38, 40 and 41.

Discussion:

Fran the information given in Appendix C, it can be seen that metal powder additions currently result in higher consumables costs, based on small-scale purchases of metal powder. Assuming that the cost of metal powder is reduced to nearly the same level as the electrode (based on large-scale purchases of metal powder), the cost of constables is lower for metal powder additions than for conventional SAW-AU. This is due to the reduced amounts of flux and wire necessary to camplete the weld. Specifically, the consumable cost of a 2" thick double-bevel HY-80 joint could be $0.72 per foot less than conventional SAW-AU, and the consumable cost for a 2" thick one-sided HY-80 joint could be $0.86 per foot less than SAW-AU. Storage and handling of the metal powder required no special controls, either for temperature or humidity. Between shifts the metal powder remained in the powder hopper, and when not in use, it was kept in a closed plastic bag.

For the purposes of clarity, the remainder of this discussion will be divided into three sections: (1) Carbon Steel/HTS Welds, (2) HY-80 Welds, and (3) Metal Powder Dispensing and related problems.

1. Carbon Steel/HTS Welds

king this part of the project, 16 joints were welded using either a 45° one-sided or 45° double-bevel joint. Heat inputs ranged from 48-96 KJ/in to cover the 400-800 amp range associated with the 5/32" diameter electrode. Powder-to-wire ratios ranging from .50:1 to 1:1 were used with M-13K metal powder during the initial work (M729-1 through -13). It was later determined that-a 1.25:1 powder-to~wire

TABLE 1

LIST OF JOINT VARIATIONS AND DEPOSITION RATES

JOINT NO	BASE MATERIAL	HEAT INPUT (KJ/IN)	POWDER-TO-WIRE RATIO	JOINT DESIGN	ACTUA DEPOSIT (LBS/H
M729-1	HTS	62.2	1.00:1	45° B1V.3	31
M729-2	HTS	48.0	.50:1	45° B1V.3	18
M729-3	HTS	67.2	1.00:1	45° B1V.3	60
M729-4	HTS	58.8	1.00:1	45° B1V.3	37
M729-5	HTS	48.0	No Powder	45° B1V.3	14
M729-9	HTS	61.2	1.00:1	45° B2V.3	21
M729-10	HTS	51.2	1.00:1	45° B2V.3	22
M729-11	HTS	51.2	.50:1	45° B1V.3	14
M729-12	HTS	61.7	.50:1	45° B1V.3	34
M729-13	HTS	64.0	.50:1	45° B1V.3	40
M729-16	HY-80	49.5	1.00:1	45° B2V.3	N/R
M729-17	HY-80	53.4	1.25:1	45° B2V.3	N/R
M729-18	HY-80	85.0	1.00:1	45° B2V.3	N/R
M729-19	HY-80	53.4	1.00:1	45° B2V.3	22
M729-20	HY-80	53.4	1.25:1	45° B2V.3	36
M729-21	HY-80	53.4	1.50:1	45° B2V.3	25
M729-24	HY-80	85.0	1.25:1	45° B2V.3	27
M729-26	HY-80	85.0	.75:1	45° B2V.3	21
M729-27	HY-80	53.4	1.25:1	45° B2V.3	N/R
M729-28	HY-100	53.4	1.25:1	45° B2V.3	N/R
M729-29	HY-80	53.4	1.25:1	45° B2V.3	N/R
M729-31	HY-80	106.4	.50:1	45° B2V.3	27
M729-32	HY-80	106.4	.75:1	45° B2V.3	31
M729-33	HY-80	106.4	1.00:1	45° B2V.3	29
M729-36	HY-80	106.4	.50:1	45° B2V.3	26
M729-37	HY-80	85.0	1.00:1	45° B2V.3	23
M729-38	HY-80	85.0	1.25:1	45° B2V.3	N/R
M729-40	HY-80	85.0	1.25:1	45° B2V.3	N/R
M729-41	HY-80	85.0	1.25:1	45° B2V.3	N/R
M729-45	HY-80	85.0	1.25:1	45° B2V.3	N/R
M729-47	HY-80	53.4	1.25:1	20° B1V.3	27
M729-48	HY-80	53.4	1.25:1	PT2S.2	N/R
M729-49	HY-80	51.0	1.25:1	PT2S.2	N/R
M729-51	HY-80	53.4	1.25:1	PT2S.2	N/R
M729-52	HY-80	85.0	1.25:1	PT2S.2	N/R
M729-53	HY-80	53.4	1.25:1	20° B1V.3	N/R
M729-54	HY-80	85.0	.75:1	20° B1V.3	N/R
M729-55	HY-80	106.4	.50:1	45° B2V.3	N/R
M729-56	HY-80	83.6-85.0	1.25:1	45° B2V.3	N/R
M729-64	CS	62.3	1.25:1	45° B2V.3	22
M729-66	CS	64.8	1.25:1	45° B2V.3	27
M729-67	CS	76.8-96.0	1.25:1	45° B2V.3	27
M729-68	CS	64.8	1.25:1	45° B2V.3	26
M729-69	CS	76.8	1.25:1	45° B2V.3	29

TABLE 1 (CONTINUED)

LIST OF JOINT VARIATIONS AND DEPOSITION RATES

JOINT NO	BASE MATERIAL	HEAT INPUT (KJ/IN)	POWDER-TO-WIRE RATIO	JOINT DESIGN	ACTUAL DEPOSITION (LBS/HR)
M729-70	CS	64.8	No Powder	45° B2V.3	18
M729-72	CS	76.8-96.0	No Powder	45° B2V.3	18
M729-73	HY-80	55.0	No Powder	45° B2V.3	23
M729-74	HY-80	85.0	No Powder	45° B2V.3	20

TABLE 2

FILLER METAL/BASE MATERIAL CHEMICAL ANALYSES; CARBON STEEL/HTS

	C	Mn	Si	P	S	Cr	Ni	Mo	Cu
Oerlikon M-13K Metal Powder (typical)	0.07 to 0.19	0.90 to 1.40	0.45 to 0.70	0.03 max	0.035 max				0.30 max
Oerlikon EL-12 Metal Powder (typical)	0.07 to 0.15	0.35 to 0.60	0.05 max	0.03 max	0.035 max				0.30 max
MIL-A1 of MIL-E-18193	0.07 to 0.14	0.35 to 0.55	0.03 max	0.03 max	0.035 max				0.30 max
Carbon Steel of MIL-S-22698	0.18 max	0.90 to 1.60	0.10 to 0.50	0.04 max	0.04 max	0.25 max	0.40 max	0.08 max	0.35 max
High Tensile Steel of MIL-S-24113	0.20 max	0.90 to 1.35	0.15 to 0.45	0.035 max	0.040 max	0.25 max	0.25 max	0.08 max	0.35 max

TABLE 3

FILLER METAL/BASE MATERIAL CHEMICAL ANALYSES; HY-80

	C	Mn	Si	P	S	Cr	Ni	Mo	Cu
Oerlikon M2 Metal Powder (actual analysis)	0.08	1.53	0.40	<.01	<.01	0.25	1.75	0.40	0.20
MIL-100S-1 of MIL-E-23765	0.08 max	1.25 to 1.80	0.20 to 0.55	0.01 max	0.01 max	0.30 max	1.40 to 2.10	0.25 to 0.55	0.30 max
HY-80 of MIL-S-16216	0.12 to 0.18	0.10 to 0.40	0.15 to 0.35	0.025 max	0.025 max	1.00 to 1.80	2.00 to 3.25	0.20 to 0.60	0.25 max

TABLE 4

NONDESTRUCTIVE TEST RESULTS

Definitions:

MT - Magnetic Particle Inspection, tested to MIL-STD-271, accepted to NAVSHIPS 0900-003-8000 Class 1
RT - Radiographic Inspection, tested to MIL-STD-271, accepted to NAVSHIPS 0900-003-9000 Class 1
UT - Ultrasonic Inspection, tested to MIL-STD-271, accepted to NAVSHIPS 0900-006-3010 Class 1

JOINT NO.	MT BACKGOUGED SURFACE	MT FINAL WELD SURFACES	RT COMPLETED WELD	UT COMPLETED WELD
M729-1	N/A	N/A	SAT	--
M729-2	N/A	N/A	SAT	--
M729-3	N/A	N/A	SAT	--
M729-4	N/A	N/A	SAT	--
M729-5	N/A	N/A	SAT	--
M729-7	N/A	N/A	SAT	--
M729-8	N/A	N/A	SAT	--
M729-9	SAT	N/A	SAT	--
M729-10	SAT	N/A	SAT	--
M729-11	N/A	N/A	SAT	--
M729-12	N/A	N/A	SAT	--
M729-13	N/A	N/A	UNSAT-Slag	--
M729-16	SAT	SAT	SAT	--
M729-17	SAT	SAT	SAT	--
M729-18	SAT	SAT	UNSAT-Slag	--
M729-19	SAT	SAT	SAT	SAT
M729-20	SAT	SAT	SAT	UNSAT
M729-21	SAT	SAT	SAT	UNSAT
M729-22	SAT	SAT	SAT	--
M729-24	SAT	SAT	UNSAT-Slag	--
M729-26	SAT	SAT	SAT	--
M729-27	SAT	SAT	SAT	--
M729-28	SAT	SAT	SAT	--
M729-29	SAT	SAT	SAT	--
M729-31	SAT	SAT	SAT	--
M729-32	SAT	SAT	SAT	--
M729-33	SAT	SAT	SAT	--
M729-36	SAT	SAT	SAT	--
M729-37	SAT	SAT	SAT	SAT
M729-38	SAT	SAT	SAT	SAT
M729-40	SAT	SAT	SAT	SAT
M729-41	SAT	SAT	SAT	SAT
M729-47	N/A	SAT	SAT	SAT

TABLE 4 (CONTINUED)

JOINT NO.	MT BACKGOUGED SURFACE	MT FINAL WELD SURFACES	RT COMPLETED WELD	UT COMPLETED WELD
M729-53	N/A	SAT	SAT	--
M729-54	N/A	SAT	SAT	--
M729-55	SAT	SAT	SAT	--
M729-56	SAT	SAT	UNSAT-Slag	UNSAT
M729-57	SAT	SAT	UNSAT-Slag	UNSAT
M729-59	SAT	SAT	SAT	--
M729-60	SAT	SAT	UNSAT-Slag	--
M729-61	SAT	N/A	--	--
M729-62	SAT	SAT	--	--
M729-64	SAT	SAT	SAT	UNSAT
M729-66	SAT	SAT	UNSAT-LOP	UNSAT-4" LOP
M729-67	SAT	SAT	SAT	--
M729-68	SAT	SAT	SAT	--
M729-69	SAT	SAT	SAT	--
M729-70	SAT	SAT	SAT	UNSAT-7" LOF
M729-72	SAT	SAT	UNSAT-8" LOF	--

TABLE 5

MECHANICAL TEST RESULTS

JOINT NO M729-	SIDE BENDS 1/3/ SAT/UNSAT	ALL-WELD METAL TENSILE				TRANSVERSE REDUCED SECTION TENSILE 2/ KSI	BASE MAT'L
		YIELD STRENGTH 2/ KSI	TENSILE STRENGTH 2/ KSI	% ELONG 2/ PERCENT	% REDUCTION IN AREA 2/ PERCENT		
8	--	80.2	89.0	23.5	59.9	79.1	HTS
16	--	101.3	110.4	22.3	63.8	109.3	HY-80
17		99.5	110.6	22.0	64.1	109.7	HY-80
19	SAT	--	--	--	--	107.3	HY-80
20	SAT	--	--	--	--	107.7	HY-80
21	SAT	--	--	--	--	108.0	HY-80
22	UNSAT	92.2	105.0	22.8	66.8	102.7	HY-80
24	SAT	89.8	103.7	24.5	68.8	104.9	HY-80
26	SAT	91.0	105.7	21.5	57.5	103.9	HY-80
27	SAT	90.7	104.2	22.0	61.7	103.4	HY-80
28	SAT	92.6	102,9	23.0	67.6	111.3	HY-100
29	SAT	95.5	107.7	19.5	50.6	113.2	HY-80
31	UNSAT	94.8	116.0	18.5	48.2	108.3	HY-80
32	UNSAT	99.3	116.7	18.5	42.7	109.7	HY-80
33	UNSAT	88.5	113.3	19.5	51.9	110.9	HY-80
36	UNSAT	98.8	114.7	20.0	51.6	112.4	HY-80
37	SAT	97.2	113.7	24.3	58.5	113.9	HY-80
38	SAT	--	--	--	--	--	HY-80

TABLE 5 (CONTINUED)

JOINT NO	SIDE BENDS 1/3/	ALL-WELD METAL TENSILE YIELD STRENGTH 2/	ALL-WELD METAL TENSILE TENSILE STRENGTH 2/	ALL-WELD METAL TENSILE % ELONG 2/	ALL-WELD METAL TENSILE % REDUCTION IN AREA 2/	TRANSVERSE REDUCED SECTION TENSILE 2/	BASE MAT'L
40	SAT	88.8	106.1	22.3	64.0	--	HY-80
53	SAT	101.6	113.2	20.5	65.0	110.1	HY-80
54	SAT	87.7	103.8	24.0	66.9	107.6	HY-80
60	SAT	91.7	106.6	20.5	55.4	--	HY-80
64	SAT	--	--	--	--	71.7	CS
66	SAT	75.9	85.9	25.0	63.2	78.3	CS
67	SAT	71.3	82.9	26.5	63.3	69.2	CS
68	SAT	76.9	85.7	24.5	61.6	67.8	CS
69	SAT	73.0	83.0	25.0	63.9	68.1	CS
70	SAT	78.0	86.6	24.3	65.5	69.9	CS
72	--	71.9	83.3	24.0	57.6	71.1	CS
Requirements:							
CS/HTS	Weld Metal	N/R	N/R	N/R	N/R	N/R	
	Base Metal	34 min	N/R	21	N/R	58-71	
HY-80	Weld Metal	82 min	N/R	16	N/R	N/R	
	Base Metal	80-99.5	N/R	20	N/R	99.5 Min	

NOTES:

1/ All side bends used a 1-1/2" mandrel, three specimens.
2/ Average of two specimens.
3/ No open fissures or cracks greater than 1/8".

TABLE 6

IMPACT TEST RESULTS

JOINT NO M729-	CVN TEST TEMP °F	CVN IMPACT ENERGY FT LBS	AVG CVN ENERGY 1/ FT LBS	CVN LOCATION	DT TEST TEMP °F	DT ENERGY FT LBS	BASE MAT'L
8	-20	15.8,24.1,13.8	17.9	WM	--	--	HTS
	0	17.7,37.8,14.0	23.2	WM	--	--	
	20	32.3,36.8,27.8	32.3	WM	--	--	
	40	33.7,65.6,29.7	43.0	WM	--	--	
	60	62.3,59.0,31.6	51.0	WM	--	--	
16	-60	57.8,59.0,48.2,45.2,59.7	55.0	WM	--	--	HY-80
	0	88.7,76.4,80.3,82.2,86.6	83.0	WM	--	--	
17	-60	56.7,66.2,72.0,64.5,72.1	67.6	WM	--	--	HY-80
	0	83.0,81.6,90.6,81.5,87.7	84.1	WM	--	--	
19	-60	52.7,82.0,49.1,66.9,58.5	59.4	WM	--	--	HY-80
20	-60	61.7,75.6,73.5,49.1,78.9	70.3	WM	--	--	HY-80
21	-60	73.9,61.4,40.4,47.6,50.9	53.3	WM	--	--	HY-80
22	-60	57.2,58.0,58.4,56.8,73.2	57.8	WM	--	--	HY-80
24	-60	96.9,91.5,87.8,47.4,56.2	78.5	WM	--	--	HY-80
26	-60	51.4,61.5,59.3,52.9,48.7	54.5	WM	--	--	HY-80
27	-60	61.2,74.0,67.2,64.9,71.9	68.0	WM	--	--	HY-80
	0	95.1,77.8,81.5,93.3,96.0	90.0	WM	--	--	
	20	87.5,93.7,89.7,104.8,88.3	90.6	WM	--	--	
28	-60	71.9,68.7,74.8,68.9,60.0	69.8	WM	--	--	HY-100
29	-60	70.0.62.3,79.1,56.6,65.0	65.8	WM	--	--	HY-80
	-40	71.5,76.5,58.3,80.1,69.8	72.6	WM	--	--	
	-20	85.7,68.2,89.4,71.1,90.8	82.1	WM	--	--	
	0	72.2,90.9,80.2,88.6,74.9	81.2	WM	--	--	
	20	93.8,88.5,95.9,84.8,94.5	92.3	WM	--	--	
31	-60	49.1,35.4,29.5,53.9,33.6	39.4	WM	--	--	HY-80
	0	68.5,66.4,69.6,57.4,86.3	68.2	WM	--	--	

TABLE 6 (CONTINUED)

JOINT NO M729-	CVN TEST TEMP °F	CVN IMPACT ENERGY FT LBS	AVG CVN ENERGY 1/ FT LBS	CVN LOCATION	DT TEST TEMP °F	DT ENERGY FT LBS	BASE MAT'L
32	-60	45.1,23.6,53.3,39.3,50.7	45.0	WM	--	--	HY-80
	0	56.7,66.6,54.5,76.7,66.8	63.4	WM	--	--	
33	-60	20.5,18.2,45.8,45.4,39.8	35.2	WM	--	--	HY-80
36	-60	51.1,46.9,42.1,61.6,64.9	53.2	WM	--	--	HY-80
	0	73.0,72.9,69.8,90.3,88.7	78.2	WM	--	--	
37	-60	29.1,54.3,32.0,37.2,25.3	32.8	WM	-20	272.4,420.0	HY-80
	0	70.9,68.4,69.8,63.6,60.7	67.3	WM	30	661.0,730.3	
	-60	33.9,30.4,36.7,24.5,40.9	33.7	WM	--	--	
	0	66.1,71.0,69.9,58.0,70.0	68.7	WM	--	--	
40	-60	49.5,28.5,46.2,35.6,46.8	42.5	WM	-20	272.8,301.9	HY-80
	0	49.0,66.6,48.6,76.9,52.4	56.0	WM	30	723.7,508.4	
	-60	46.5,48.4,45.2,53.5,42.9	46.7	FL	--	--	
	-60	64.3,43.8,49.1,46.7,49.2	48.3	+1 mm	--	--	
	-60	36.0,38.9,49.1,34.4,41.0	38.6	+3 mm	--	--	
	-60	40.4,35.3,42.2,38.2,40.2	39.6	+5 mm	--	--	
45	-60	47.7,45.3,50.8,57.8,40.1	47.9	Top WM	--	--	HY-80
	0	68.3,85.9,89.1,91.4,69.6	81.5	Top WM	--	--	
	-60	40.3,35.8,40.0,39.3,30.9	38.4	Bot WM	--	--	
	0	60.2,69.6,60.5,65.5,58.9	62.1	Bot WM	--	--	
53	-60	33.5,79.8,135.4,67.6,126.6	91.3	WM	--	--	HY-80
	0	97.1,135.6,93.7,133.4,97.1	109.2	WM	--	--	
54	-60	49.5,54.9,44.9,54.1,41.4	49.5	WM	--	--	HY-80
	0	82.0,60.2,79.3,62.9,79.1	73.8	WM	--	--	
59	-60	39.7,48.9,35.6,36.8,39.4	38.6	WM	-20	429.0,312.9	HY-80
	0	82.8,53.7,76.7,58.9,64.1	66.6	WM	30	714.2,599.1	
60	-60	69.3,46.2,76.5,50.1,71.2	63.5	WM	--	--	HY-80
	0	64.5,85.0,69.8,93.8,66.1	73.6	WM	--	--	
64	30	22.7,30.9,37.7,31.1,29.2	30.4	WM	--	--	CS
	0	16.7,11.7,15.7,22.2,12.6	15.0		--	--	
66	30	62.1,64.6,55.8,54.3,49.1	57.4	WM	--	--	CS
	0	53.5,26.9,46.5,17.9,37.3	36.9				
67	30	50.2,39.4,38.6,34.8,37.2	38.5	WM	--	--	CS
	0	25.9,40.8,23.8,37.9,57.6	34.9	WM	--	--	

TABLE 6 (CONTINUED)

JOINT NO M729-	CVN TEST TEMP °F	CVN IMPACT ENERGY FT LBS	AVG CVN ENERGY 1/ FT LBS	CVN LOCATION	DT TEST TEMP °F	DT ENERGY FT LBS	BASE MAT'L
68	30	30.0,69.6,36.2,23.1,31.7	32.6	WM	--	--	CS
	0	15.7,15.6,18.8,20.5,41.5	18.3	WM	--	--	
	-20	12.9,13.2,23.0,16.1,17.1	15.5	WM	--	--	
69	30	47.3,58.2,42.7,47.2,49.3	48.0	WM	--	--	CS
	0	46.5,33.3,18.4,22.9,30.1	28.8	WM	--	--	
	-20	23.2,12.6,11.3,12.8,17.9	14.4	WM	--	--	
70	30	55.2,45.9,56.4,33.8,38.8	46.6	WM	--	--	CS
	0	24.8,18.4,30.7,34.2,18.0	24.6		--	--	
72	30	34.0,66.2,32.7,34.7,45.7	38.1	WM	--	--	CS
	0	17.0,32.1,20.5,38.6,41.4	30.4	WM	--	--	
Requirements:							
CS/HTS	-20°		For information only				
HY-80	-60°		35	WM	-20°	300 2/	
	0°		60	WM	30°	450 3/	

NOTE:

1/ Average CVN values are determined from five specimens by disregarding the high and low values and averaging the three middle values.
2/ One specimen may be 50 ft lbs low.
3/ One specimen may be 25 ft lbs low.

ratio prOVided the optimum cambination of deposition rate, mechanical properties, and minimized the loss of unfused metal poeder (based on HY-80 work). The remainder of the carbon steel/HIS joints (M729-64 through -72) used either a 1.25:1 powder-to-wire ratio or no powder for comparison.

The initial carbon steel/HTS joints were destructively tested and the results reviewed while the HY-80 part of the project was being welded. Joint M729-8 had higher strength levels than expected (see Table 5), and further investigation revealed that the low-manganese 512 powder would be better suited to the low-managanese MIL-Al electrode than the high-manganese M-13K metal. powder. Joints M729-68 through -69 used EL12 powder, and these joints had strength levels more closely matched to the base material requirements.

Figures 9 and 10 show macrophotographs comparing joints M729-68 (600 amps with 1.25:1 EL-12) and M729-70 (600 amps with no powder). Using metal powder additions at 600 amps, the number of beads needed to camplete the 2" thick joint was reduced from 31 to 22, and the deposition rate was increased from 18 lbs/hr to 26 lbs/hr; a 44% increase. Figures 11 and 12 show macrophotographs comparing joints M729-69 (800 ampswith 1.25:1 EL-12) and M729-72 (800 amps with no powder). Using metal powder additions at 800 amps, the number of beads needed to complete the 2" thick joint was reduced from 22 to 18, and the deposition rate-was increased from 18 to 29 lbs/hr; a 61% increase.

Both joints M729-68 and -69 could be used to satisfy the procedure qualification requirements of ML-STD-248C. All nondestructive and destructive testing was performed as outlined in MIL-STD-248C with acceptable results. Both joints together will qualify metal powder additions of 1.25:1 or less for the entire range 400-900 amps on carbon steel/HTS welds from 3/16" to 4" thick. This process can be used on double-bevel, one-sided, and fillet joint designs in the flat position.

2. HY-80 Welds

During this part of the project, 31 joints were welded using three different joint designs: 45° double bevel joints, 20° one-sided joints and flat fillets. Initially, heat input levels of 55, 85 and 110 KJ/in were used to determine the optimum powder-to-wire ratio and heat input for double-bevel joints. Joints M729-16, -17, -19, -20 and -21 were welded at 55 KJ/in using poeder-to-wire ratios ranging from 1:1 to 1.5:1. Table 6 shows that the impact strength was highest at 1.25:1. Also, the amount of unfused metal powder (seen along the edges of the solidified slag) was nearly the same as 1:1 but considerably less than the amount left at 1.5:1. Therefore, the 1.25:1 powder-to-wire ratio was chosen as optimum for 55 KJ/in heat input. Joints M729-18, -24 and -26 were welded at 85 KJ/in using powder-to-wire ratios ranging from .75:1 to 1.25:1. Again the 1.25:1 ratio provided the highest impact strength and an acceptable amount of unfused metal powder. Joints M729-31, -32, -33 and -36 were welded at

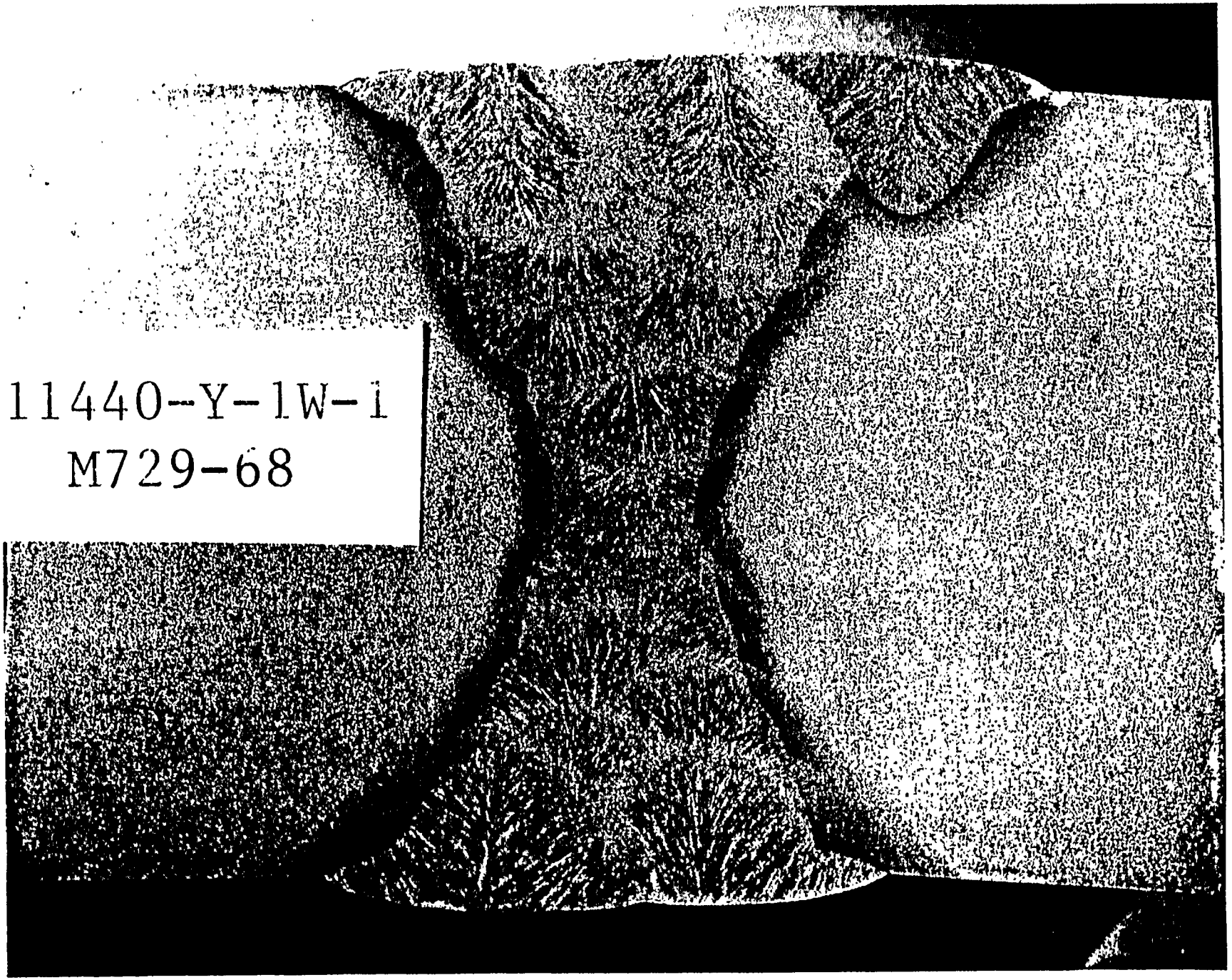


Figure 9
Macrophotogram of M[illegible]-68 weld alloys with 1.25% metal powder additions)

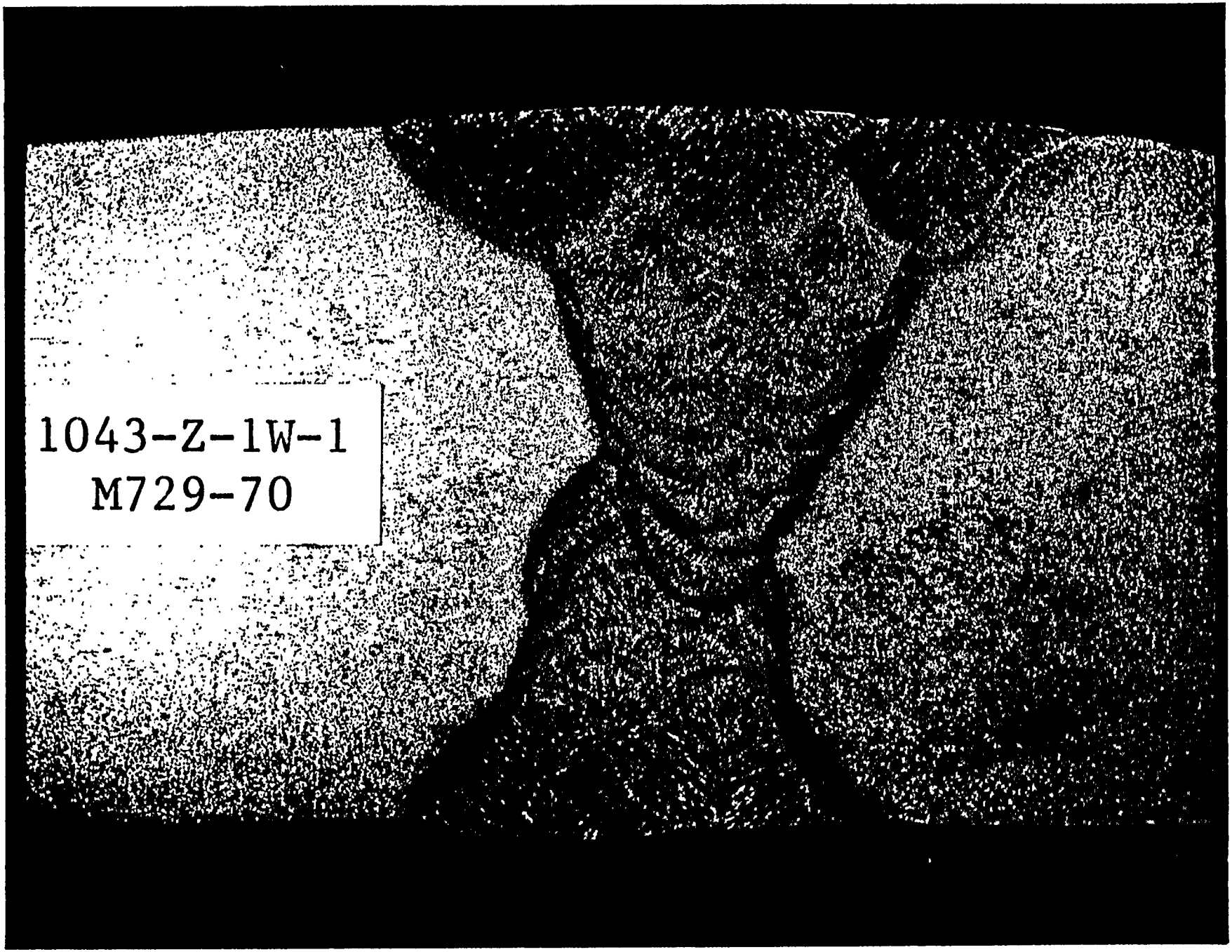


Figure 10
Macrophotograph of M729-70 (600 amps with No Metal Powder Additions)

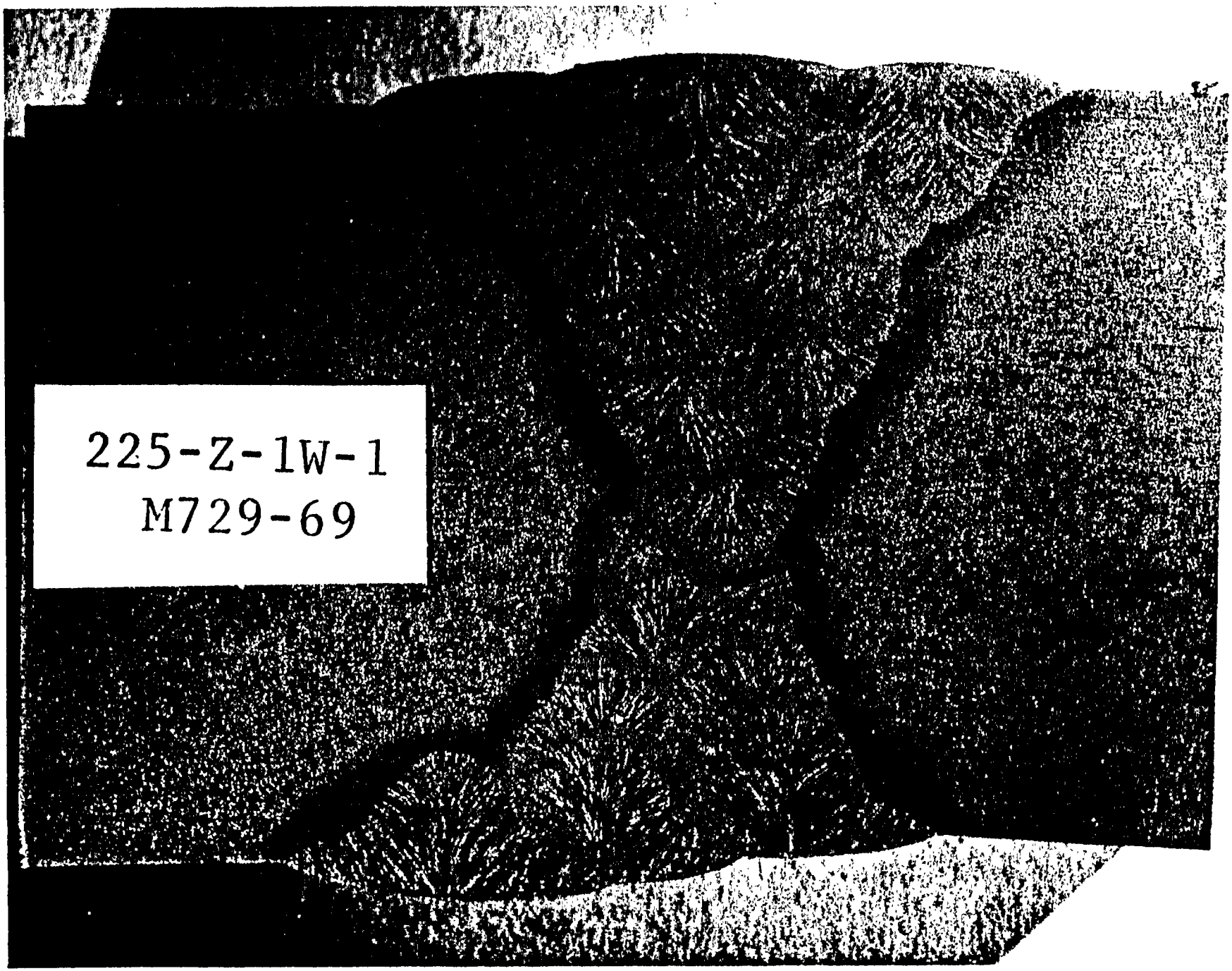


Fig. 11

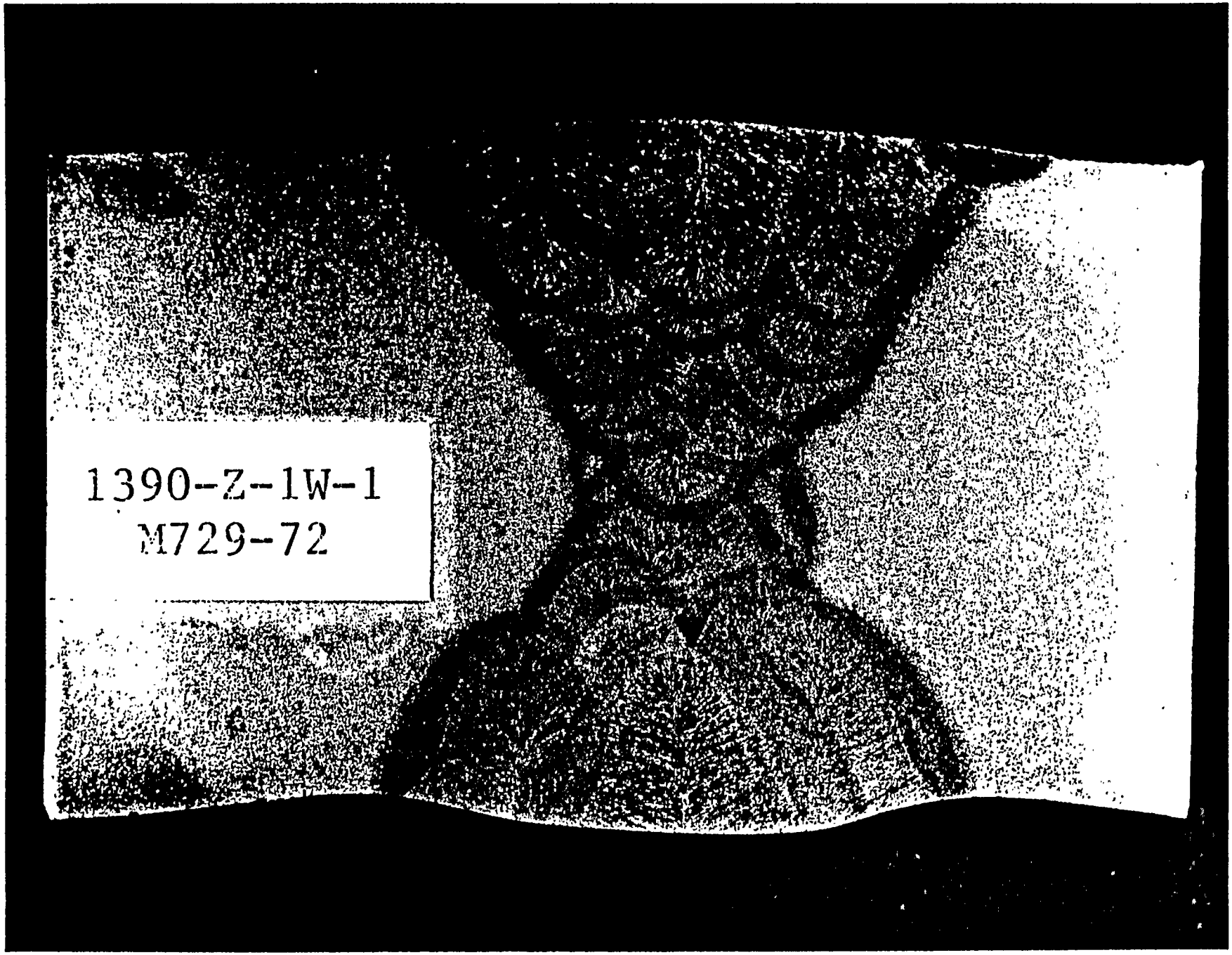


Figure 12
Macrophotograph of M729-72 (800 amps with No Metal Powder Additions)

approximately 110 KJ/in using powder-to-wire ratios ranging from .5 to 1:1. Table 5 shows that all of these joints failed side bend testing. Based on that information, the 110 KJ/in welding was not pursued any further.

Since the mechanical and impact results for 55 and 85 KJ/in bo met the requirements, and the 85 KJ/in heat input gave higher deposition rates, the optimum cambination for 45° double-bevel join was selected to be 85 KJ/in. using a 1.25:1 powder-to-wire ratio. Figure 13 **shows** microptitographs of a conventional SAW-AU weld at 8 KJ/in and a SAW-AU with powder additions weld at 85 KJ/in. Notice that the weld with powder additions had a narrower HAZ and finer gr structure near the fusion line, as expected. Using 1.25:1 metal powder additions at 85 KJ/in, the number of beads necessary to camplete the 2" thick joint was reduced from 39 to 20, and the deposition rate was increased from 20 to 27 lbs/hr; a 35% increase (compare M729-24 and -74). Using 1.25:1 metal powder additions at KJ/in, the number of beads necessary to camplete the 2" thick joint was reduced from 31 to 14, and the deposition rate was increased fr 23 to 36 lbs/hr; a 36% increase (campare M729 -20 and -73).

During the welding of the early HY-80 joints, two specifi problems were encountered. First, the solidified flux was nearly impossible to remove from the root Pass when metal powder was used the root. Second, the use of metal powder for the reinforcement passes caused the height of the crown to exceed the specification limits, and grinding was required to reduce the crown to an accepta level. Figure 14 shows a comparison of average weld metal CVN valu for joints reinforced with and without powder. Discontinuing the metal powder for the reinforcement reducedthe impact values. Afte experimentation, it was found that using lower heat input without powder for root passes would allow easy slag ramoval, and discontinuing the powder for the reinforcement would eliminte the unnecessary grinding. Although both of these steps will reduce the total deposition rate slightly, and not using powder for reinforcem will slightly reduce impact strength, the reduction is more than off set by reduced labor costs for the additional grinding/chipping, particularly on long joints associated with SAW-AU. These two step then became part of the standard weld procedure.

At this point, joints M729-38, -40 and -41 were fabricated to provide **six** 30" x 30" test specimens for explosion testing. M729-4 also had a prolongation that was destructively tested prior to shipping the plates for explosion testing. All mechanical properti of the prolongation except for CVN impact strength at 0°F met the MIL-SID-248C requirements. (See Tables 5 and 6.) The Charpy V-not tests conducted at 0°F and one dynanic tear (DT) test at -20°F were below specification although the low DT is allowed for MIL-STD-248C qualification. Discussion with NAVSEA suggested that the explosion tests be conducted since only one DT was low, and since all of the weld metal/HAZ CVN's at -60°F were satisfactory. The explosion testing was conducted by Mare Island Naval Shipyard at the Army Ammunition Plant in Hawthorne, Nevada. This testing consisted of t parts: (1) Explosion Crackstarter testing and (2) Explosion Bulge

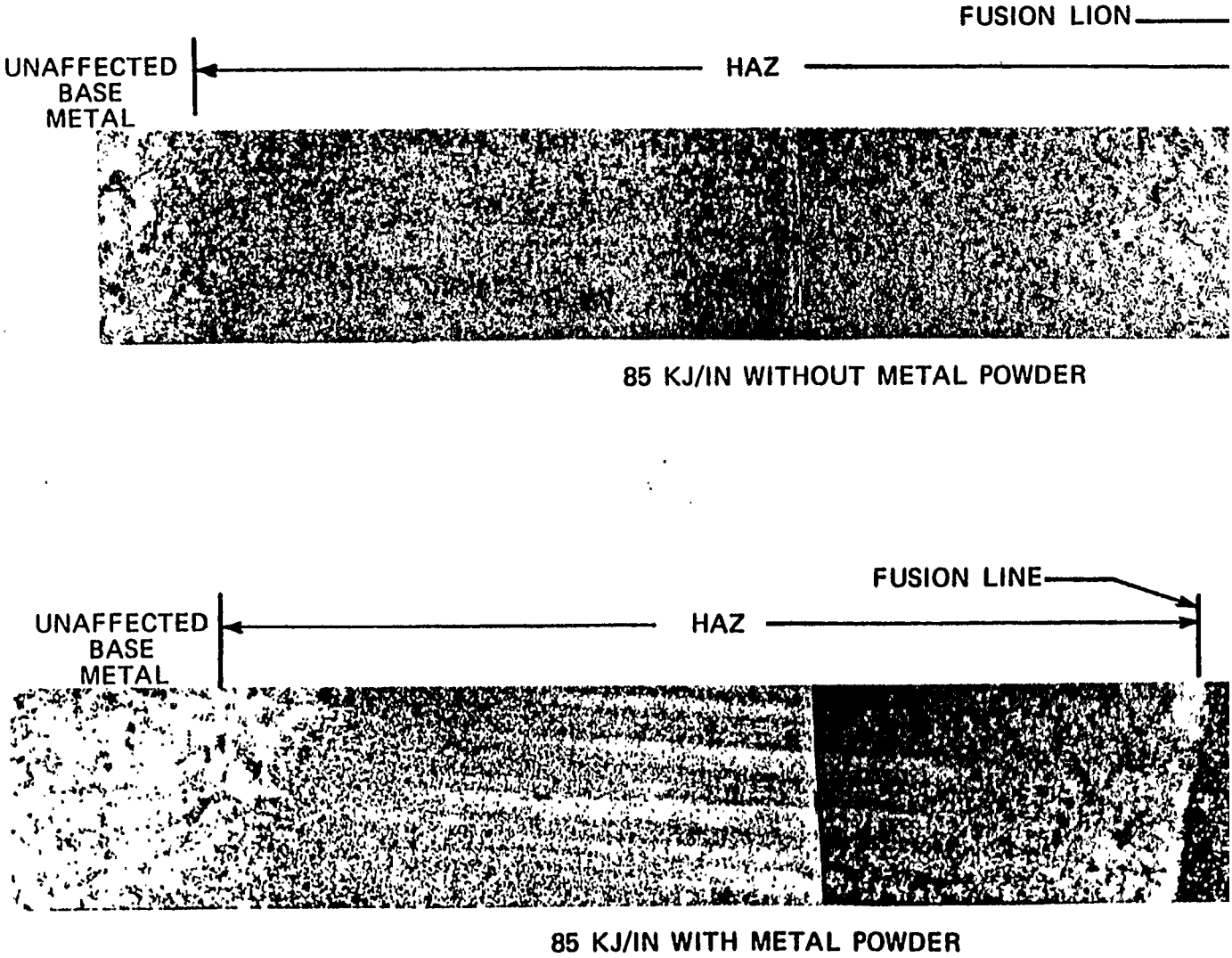


Figure 13
Microphotographs Across HY-80 Heat Affected Zones; Metal Powder Additio
Powder Additions (Equal Magnification, Approximately 50x)

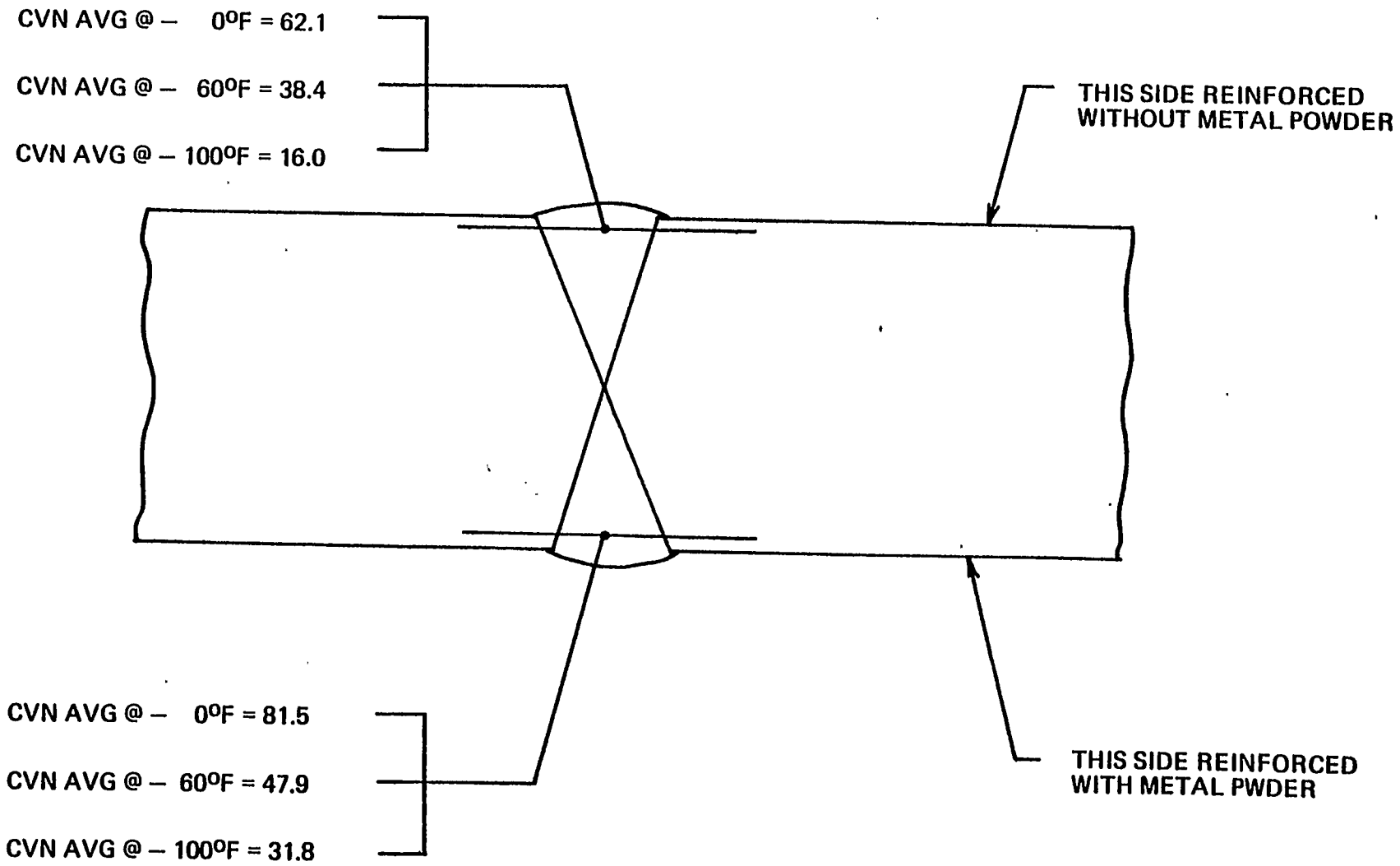


Figure 14
Average Weld Metal CVN's (in ft lbs) for HY-80; Metal Powder Reinforcement vs. No Metal Powder Reinforcement

testing, which together provide a harsh test of the entire weld zone. The crackstarter test uses artificially created "notches"; one transverse, and one longitudinal, that are each explosively loaded twice to see if the welding deposit is capable of keeping the crack from propagating either through the plate thickness, or into the hold-down area. The bulge test uses explosive loading through successive shots to try and achieve 16% minimum reduction in thickness without a crack propagating either through the plate thickness, or into the hold-down area.

After the explosion testing was successfully completed, work centered around the two other joint designs that could be encountered. The first was a fillet. Joints M729-48 and -49 were used to establish parameters for an 85 KJ/in flat fillet. Joint M729-50 was tried in the horizontal position and proved that since the metal powder falls on the bottom plate, SAW-AU with metal powder additions cannot be used for an equal-legged horizontal fillet. Joint M729-51 was welded with 1.25:1 powder-to-wire at 55 KJ/in in the flat fillet position and is shown in Figure 15. Joint M729-52 was welded with 1.25:1 powder-to-wire at 85 KJ/in in the flat fillet position and is shown in Figure 16.

Joints M729-42, -43, -44 and -46 were used to establish root pass parameters (without metal powder) for 20° one-sided, backing strap joints. Acceptable parameters for the root (425A, 34V, 15ipm) were used to produce the weld pass shown in Figure 17. M729-47 was welded with 1.25:1 powder-to-wire at 55 KJ/in and is shown in Figure 18. M729-54 was successfully welded using .75:1 powder-to-wire at 85 KJ/in.

As outlined in MIL-STD-248C, joint M729-40 will qualify the use of SAW-AU with M-2 metal powder additions (ratios 1.25:1 and lower) up to 85 KJ/in. Transverse tensiles of that joint were not tested, however, based on the remainder of the data and successful explosion testing of the same joint, it is considered complete data.

3. Metal Powder Additions and Related Problems

During the course of this project, there were no mechanical difficulties with the metal powder dispensing system. It was easily adapted to either the portable track-mounted SAW-AU carriage or the permanent side-beam SAW-AU carriage. The only major obstacle was determining the correct dial setting for a particular powder-to-wire ratio. The method used in this project was usable; however, it was found that changing or adjusting the dial potentiometer required recalculating the graphs and tables.

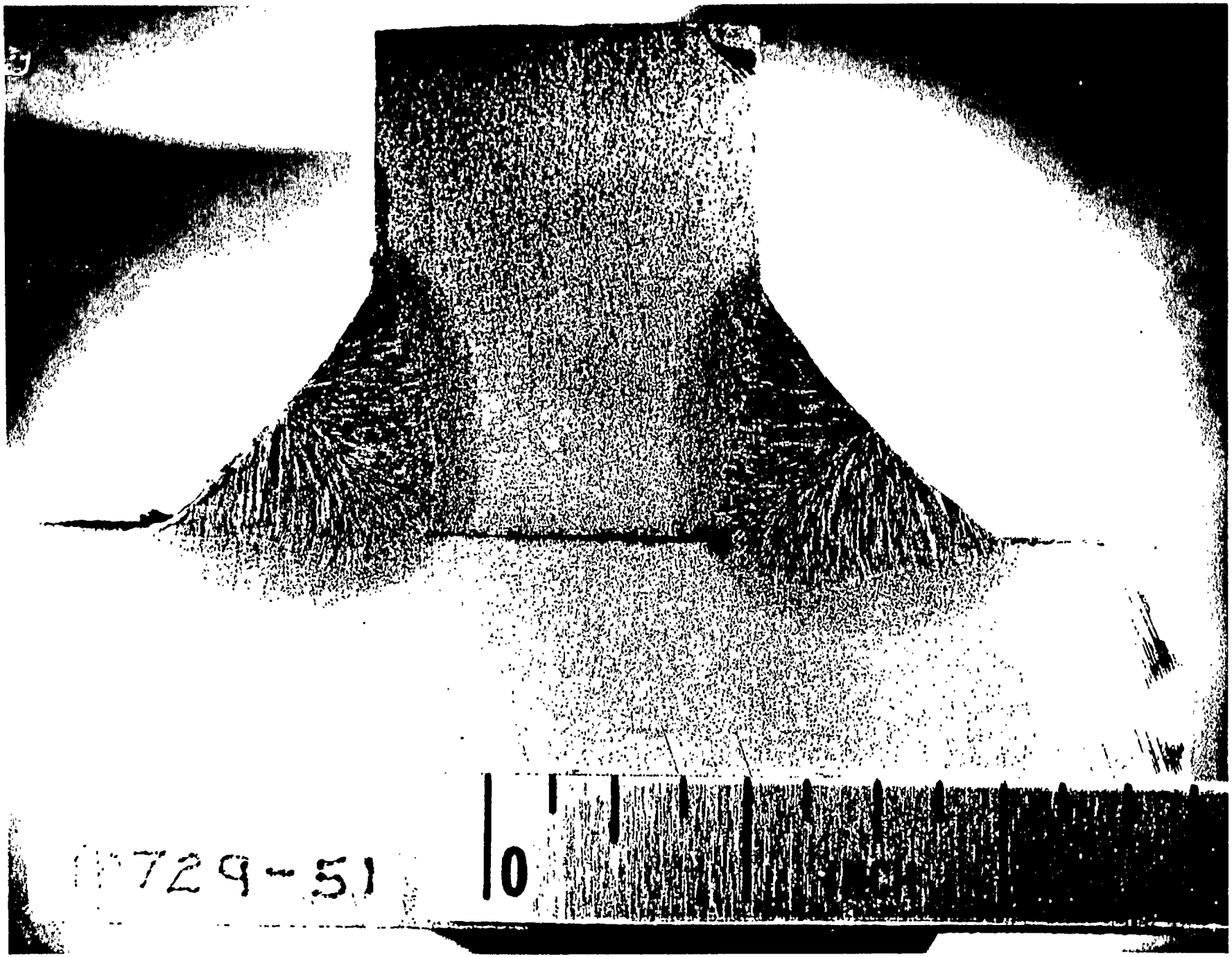


Figure 15
Macrophotograph M729-51

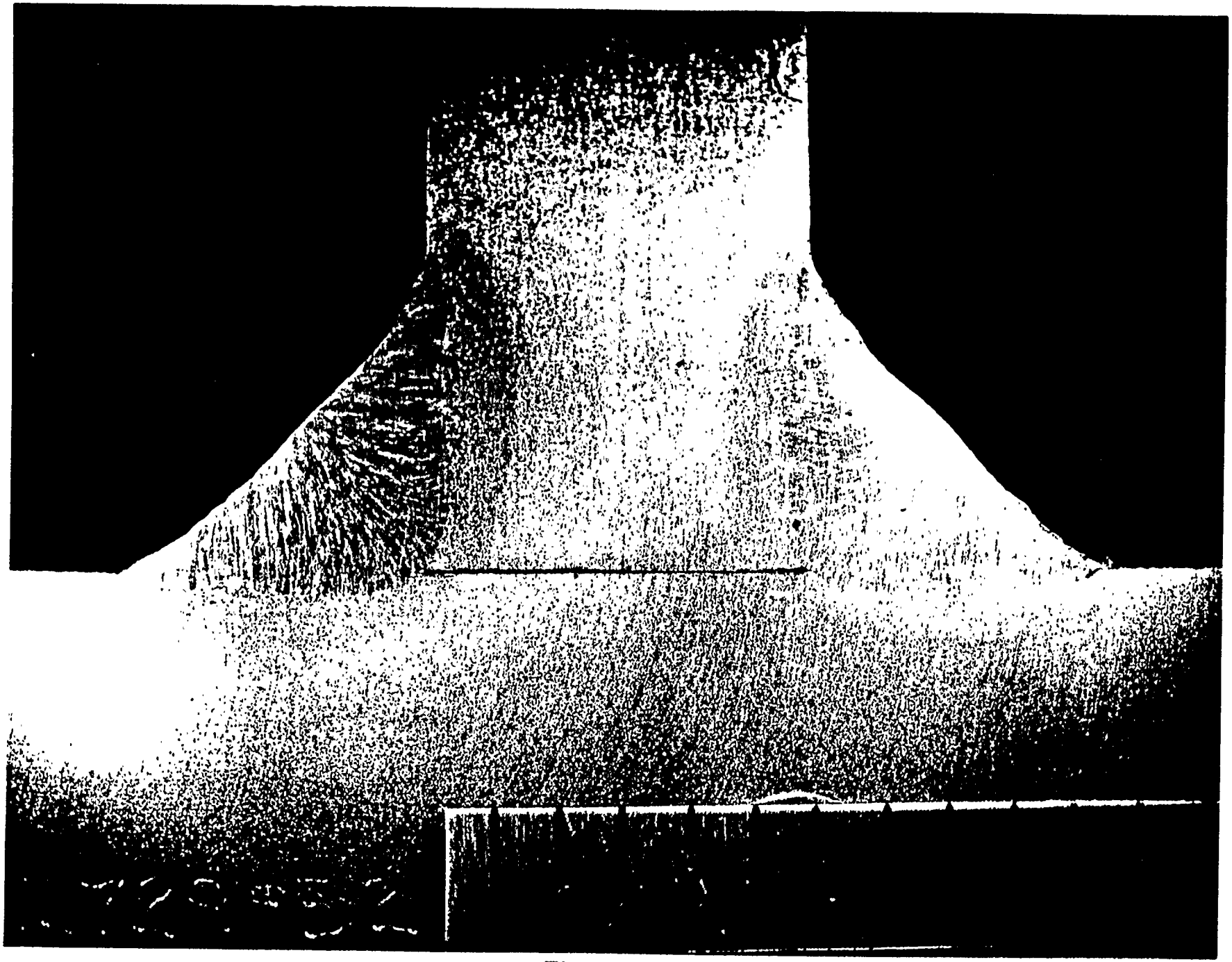


Figure 16
Macrophotograph of M729-52

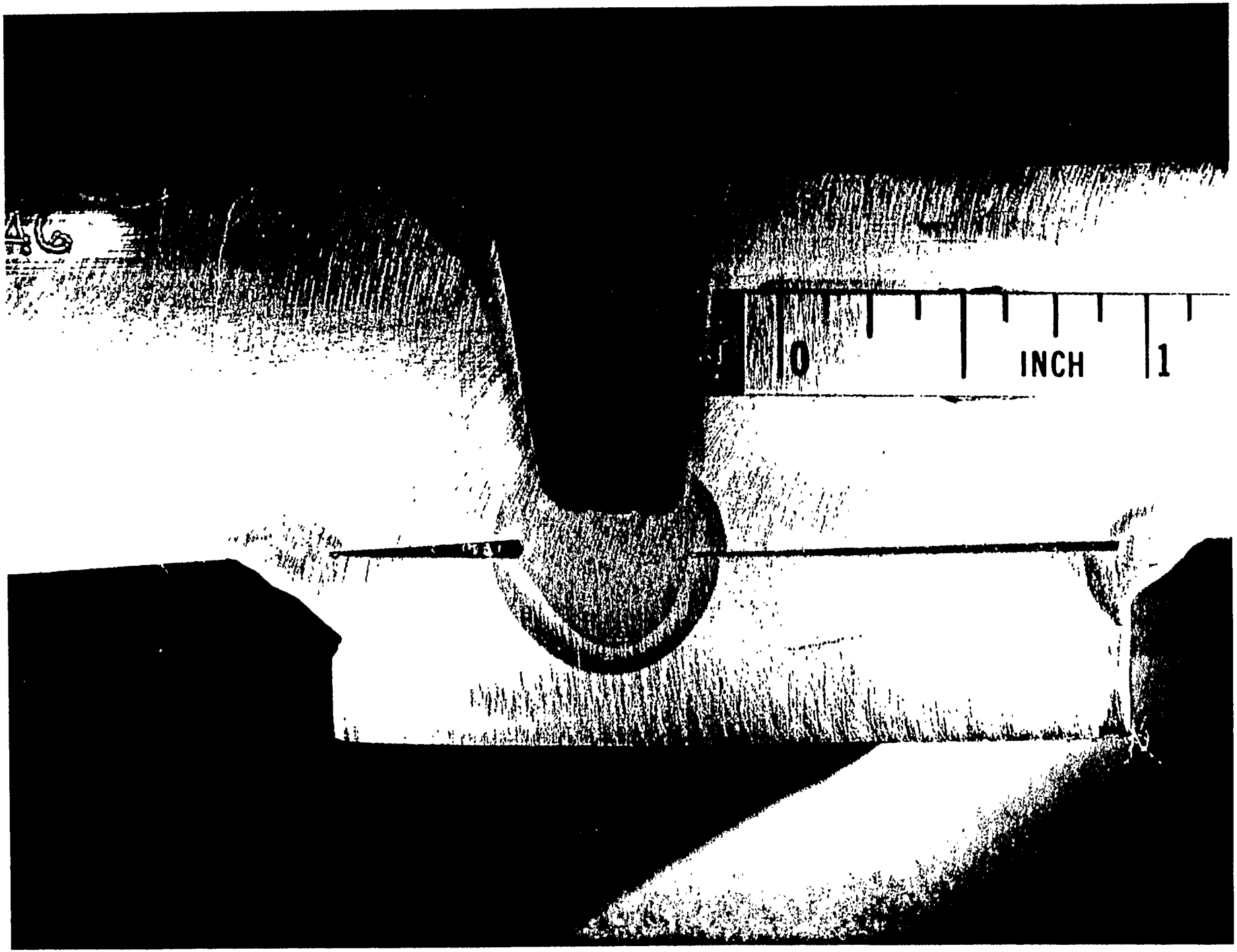


Figure 17
Mac phot , apl M7 46 t Pa

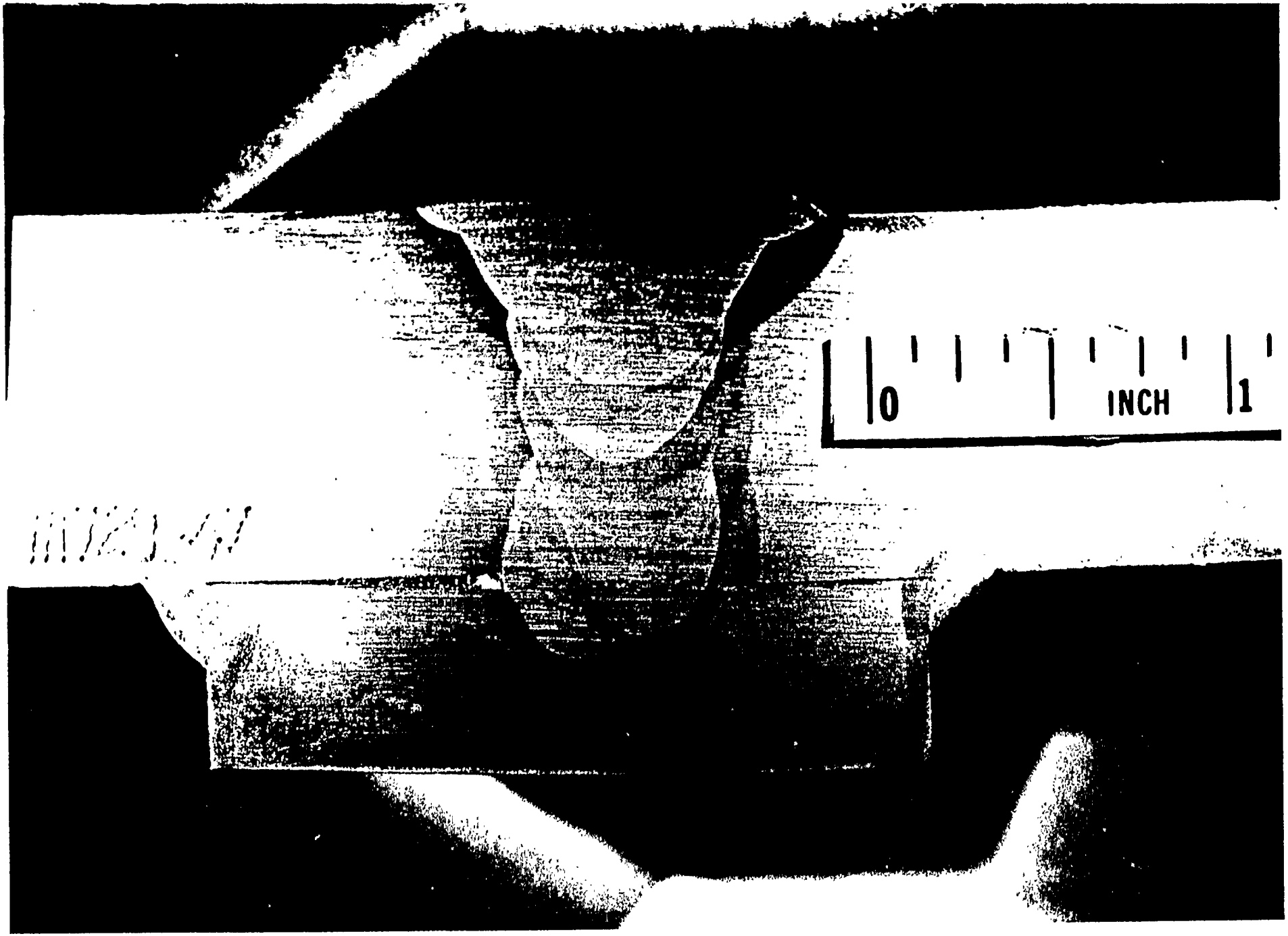


Figure 18
Macrophotograph of M729-17

The need for graphs, tables and calculations to determine the correct dial setting for a particular powder-to-wire ratio and powder causes several concerns:

a. Each powDer dispensing meter would require calibration and/or a separate set of graphs and tables.

b. The welder would have to determine the dial setting - this is difficult to do without a calculator. During this project, the technician was supplied with the correct dial. setting in his instruct ions from the engineer.

c. Without a limiter on the maximun dial setting, it is possible that the welder could deposit excessive amounts of metal powder and cause defects such as lack of fusion or trapped slag.

The use of metal powder, which increases the size of the weld deposit and tends to cool the puddle can multiply the frequency of trapped slag. Figure 19 is a graphic example of this most often occurring discontinuity associated with both conventional SAW-AU, and SAW-AU with metal powder additions. The two major causes for this most common discontinuity are improper bead placement and excessive travel speed. During the course of the project, it was discovered that slower travel speeds helped ensure complete consumption of the metal powder into the puddle. While admittedly being a problem for both techniques, (SAW-AU and SAW-AU with metal powder additions), the problem is not so large as to defeat the practicality of the process. To test this., a new technician who had never before welded SAW-AU was started on joint M729-61. The next three joints provided enough practice for him to become proficient with the bead placenent, so that with the exception of a 4" discontinuity near the run-on tab, joints M729-64 through -70 were all RT acceptable.

Conclusions:

1. The use of **controlled** metal powder additions to SAW-AU will increase deposition rates up to 60% over conventional SAW-AU. The smaller number of beads will help reduce distortion. 45° minimun double-bevel, 20° minimum one-sided, and flat fillet joint designs can be used.

2. The *use* of SAW-AU with metal powder additions at higher heat inputs (up to 85 KJ/in) will. provide acceptable mechanical properties. reduce the width of the heat affected zone, and produce a finer HAZ grain size.

3. Procedure qualification of metal powder additions to SAW-AU for carbon *steel* materials (as outlined in MIL-STD-24$C) is possible using the data presented in this report. Oerlijon's EL-12 powder should be used with the MIL-A1 electrode.

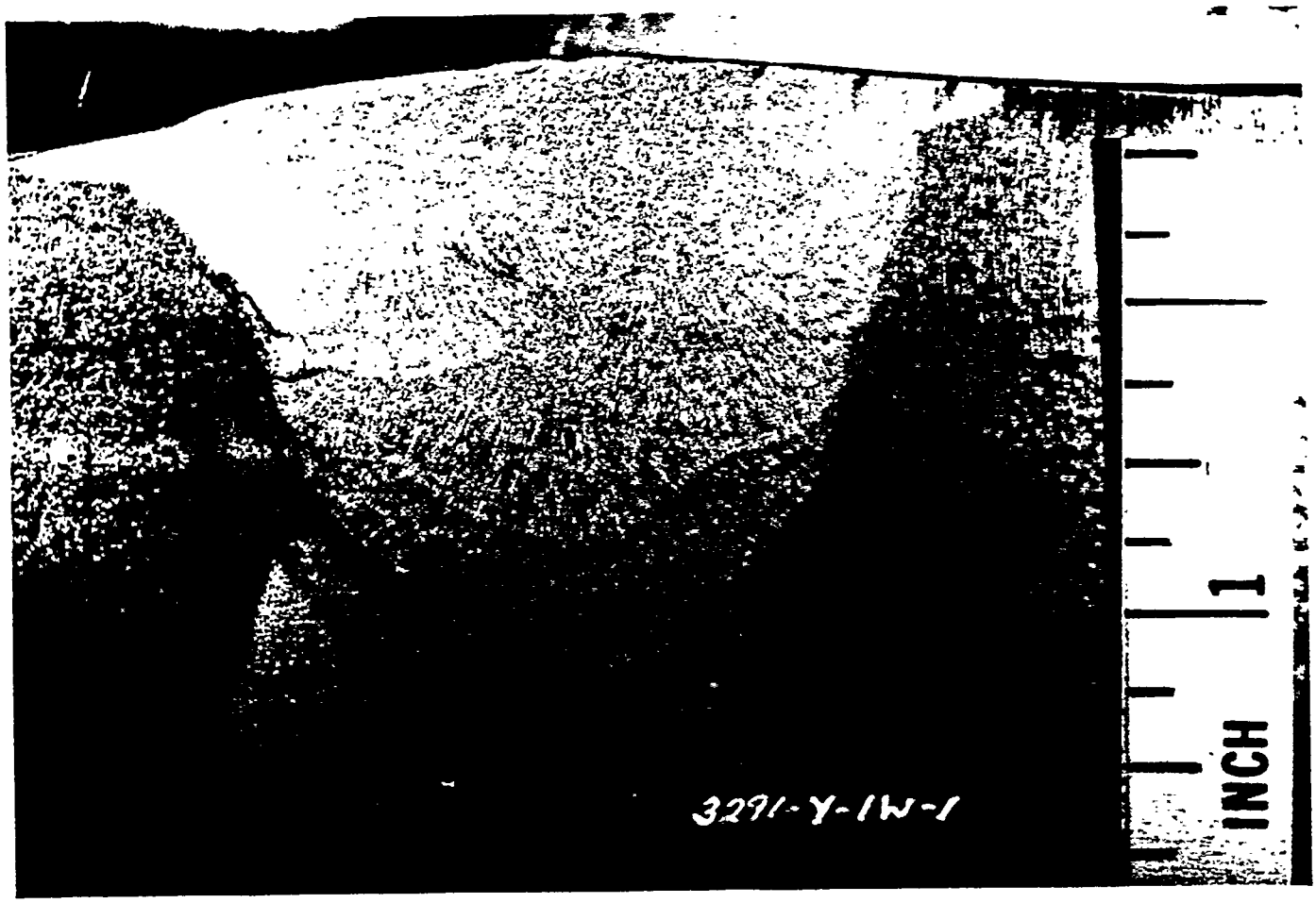


Figure 19
Macrophotograph of Trapped Slag Discontinuity

4. Procedure qualification of metal powder additions to SAW-AU for HY-80 materials (as outlined in MIL-STD-248) is possible using the data presented in this report. Oerlikon's M-2 powder should be used with the MIL-1OOS-I electrode.

Recommendations:

1. Further Work at the 110 KJ/in heat input level on Hy-80 should be pursued. The RT quality was acceptable, and an increase in deposition rate was realized; however, the side bend failures were reason enough to stop work at that level due to the limitations.

2. Sane way of controlling the powder-to-tire ratio without the me of graphs and tables should be explored. Perhaps a microprocessor control that senses wire feed speed could be utilized. That way the operator would simply enter the desired powder-to-wire ratio and the microprocessor would determine (and possibly even set) the correct dial setting.

APPENDIX A

ORIGINAL TASK PROPOSAL

Newport News Shipbuilding

4101 Washington Avenue
Newport News, Virginia 23607
(804) 380-2000

TENNECO

May 17, 1983

Mr. M.I. Tanner
SNAME Panel SP-7 Program Manager
Newport News Shipbuilding
4101 Washington Avenue
Newport News, Virginia 23607

Dear Mr. Tanner,

Enclosed is our proposal to evaluate the Bulk Welding process on carbon and HY-80 steels for shipyard applications. We ask that the proposal submitted be considered for funding by the SNAME SP-7 Panel.

Due to the vast amount of submerged arc welding used at Newport News Shipbuilding and preliminary work having already been completed on the Bulk Welding process, we are very anxious to use our expertise in developing this process and are looking forward to supporting the National Shipbuilding Research Program in its effort to modernize the shipbuilding industry.

Sincerely,

B.C. Howser
Manager of Welding Engineering

dac
LAC/spw-118

PROPOSAL

WELDING OF CARBON STEEL AND HY80 UTILIZING THE BULK WELDING PROCESS

May 9, 1983

PREPARED BY:

NEWPORT NEwS SHIPBUILDING AND DRY DOCK COMPANY

L.A. Craig, Welding Engineer
Newport News, Virginia

PREPARED FOR:

SHIP PRODUCTION COMMITTEE PANEL SP-7

B.C. Howser, Manager of Welding Engineering
Newport News Shipbuilding
Newport News, Virginia

Background

Automatic Submerged Arc Welding (SAW-AU) is a high deposition welding process that utilizes a flux blanket or burden instead of a shielding gas to protect the welding arc from the atmosphere. The flux burden maintains a stable arc even at amperage ranges four or more times greater than SMAW.

The Bulk Welding process consists of the addition of powdered metal of controlled chemistry to the SAW-AU process at a specific rate. Metal powder is introduced just ahead of the electrode. As the welding arc passes over the powdered metal, the metal melts and becomes part of the weld puddle, significantly increasing deposition rate with a decrease in total heat input.

Objective

The primary objective will be to qualify a procedure that will meet military specification for both carbon and HY-80 steels utilizing the bulk welding process. This will include the following:

1 Optimum amperage, voltage, travel speed, etc.
2.* Optimum wire to powder ratio
3. Joint design and criticality of bead placement.

To determine the acceptability of the procedure, non-destructive (x-ray, magnetic particle inspection) and destructive (weld metal and HAZ mechanical properties) testing will be performed.

During the procedure qualification, other areas will be considered to determine the feasibility of the process for shipyard use. This will include storage, handling and use problems, effect on productivity, best powder addition equipment, and the effect on distortion.

Approach

A minimum of 12-1 inch thick test assemblies will be welded to determine the optimum welding parameters and wire to powder ratio. A workable range will be developed at the same time. A minimum of 24-2 inch test assemblies will then be welded; 12 joints with carbon steel and 12 with HY80, utilizing three different size double bevel joints (20, 45, 60 degrees). The joints will then be non-destructive and destructively tested to requirements of the appropriate military standard.

Benefits

1. Deposition rates utilizing bulk welding can be increased two to three times that of single wire submerged arc welding.

2. Lower total heat input.

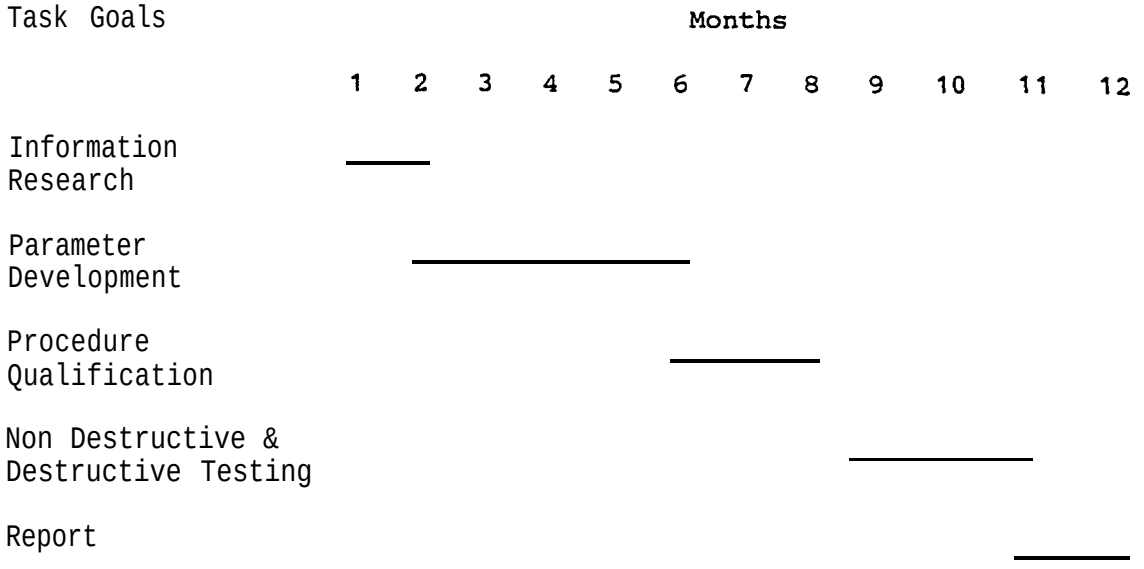
3. Less distortion

4. Submerged arc flux consumption per pound of weld metal deposited is less.

Progress Reports

Progress Reports will be provided at the end of each quarter with a detailed final report at the conclusion of the project.

TASK SCHEDULE



PROJECT COST ESTIMATE

Direct Labor

Project Engineer	(one Third Man Year)	$15,000.00
Laboratory	(One Half Man Year)	15,000

Material

HY80 Test Plates	9.000.00
Carbon Steel Test Plates	9.000.00
Consumables	2.000. 00

Testing

Non-Destructive and Destructive Testing	(One Half Man Year)	18,000.00

Travel Expenses 2,000.00

2 People - Mare Island, Vallejo, CA., 2-3 Days
(Expolosion Bulge Testing)

2 People - Tapco International, Houston, TX., 1-2 Days
(Bulk Welding Expertise)

Total Estimate $70.000.00

APPENDIX B

DIALOG WELDASEARCH

File99: Weldasearch - 1967 to Aug. 1985

Set	Items	Description

? ss (submerged (w) arc (w) welding or saw) and (metal (w) powder (w) addition? or iron (w) powder (w) addition? or powder (w) addition?

1	6137	Submerged (w) arc (w) welding
2	207	SAW
3	9	Metal (w) powder (w) addition?
4	8	Iron (w) powder (w) addition?
5	28	Powder (w) addition?
6	18	(1 or 2) and (3 or 4 or 5)

? t6/5/l-18

6/5/1
109885
Fabrication of tubular structures.
Gorton O K
In: Welding of Tubular Structures. Proceedings 2nd IIW International Conference, Boston, MA, 16-17 July 1984. Publ: Elmsford, NY 10523, USA; Pergamon Press (for the International Institute of Welding); 1984. ISBN 0-08-03115603. pp. 317-324. 5 fig., 1 ref.

Languages: English
+ English

A general review is given of welding-related developments which have evolved due to North Sea offshore structures fabrication. A brief history is given; methods for increasing submerged arc weld deposition rates are reviewed; problems of lamellar tearing and chevron cracking are explained; and the

effect of steel properties upon weld characteristics is broadly outlined. A forecast of the next developmental phase is made. Other aspects covered include: joint preparation; use of triple wires; Hi-Dep system of powder addition; weld metal COD; MMA welding.

6/5/2
108613

Machined joints or oxyacetylene cut joints for critical applications.

Hakansson L.

In: Joining of Metals (JOM-2) . Proceedings International Conference, Helsingor, Denmark, 15-18 Apr 1984. Ed: O. A. K. Al-Erhayem. Publ: Helsingor, Denmark; Ingeniorhojskolen Teknikum; 1984. PP. 194-198. 5 fig., 1 tab.

Languages: English

+ English

The effect of cutting method on the notch toughness of the weld heat affected zone was investigated. Joints were made in normalised NVE36 microalloyed steel (0.14-O.15%C, 1.42-l .43Mn, 0.19-O.002%V, 0.025-O.031%A1, 0.034-O.043%Nb), plate thickness 30 or 50 mm. The plate for one side of the groove was machined, while that for the other side was oxyacetylene cut. Welds were made by MMA welding with Tenacito 38R electrodes, or by submerged arc welding with a solid wire SD3 and flux OP121TT or flux cored wire Fluxocord 44, with or without iron powder addition to the submerged arc welds. Tensile strength and transition temperature of weld metal, and notched impact strength in the heat affected zone and at the fusion line were determined for welds as made and after heat treatment. Flame cut edges gave higher toughness values on the HAZ and lower values at the fusion line than did th machined edges. Postweld heat treatment was detrimental.

6/5/3

108598

Further improvement of narrow gap welding techniques.

Normura H., Sugitani Y.

In: Joining of Metals (JOM-2). Proceedings International Conference, Helsingor, Denmark, 15-18 Apr. 1984. Ed: O.A.K.Al-Erhayem. Pub 1: Helsingor, Denmark; Ingeniorhojskolen Helsingor Teknikum; 1984. pp. 73-85. 22 fig., 3 tab., 37 ref.

Languages: English

+ English

Recent developments in Japan to expand the use of narrow gap welding, and one technique in particular based on a rotating arc, are described. Methods used with TIG and MIG narrow gap welding include arc oscillation, twist arc (with twisted filler wire), seam tracking and feedback control of process parameters **(with** sensors operating with electric switches, arc sensing, television plus image Processing, or contact rollers), and one-sided welding on glass fibre backing tape. The high speed rotating arc variant of GMA welding uses a rotating welding nozzle having a contact tip with an eccentric guide hole. The effects of rotation speed, size of the circle described by the arc, voltage and current on weld bead shape, penetration, side wall fusion, and deposition rate were determined using mild steel welded with argon + $C0_2$ shielding gas. A seam tracking system which uses the change in arc voltage' as a sensor, and one sided welding technique with a ceramic backing (KL-3) and iron powder additions for use with the rotating arc narrow gap welding process are described.

6/5/4

108590

Trends in joining and untraditional ways of metal joining in constructions.

Staffens H. D.

In: Joining of Metals (JOM-2). Proceedings International Conference, Helsingor, Denmark, 15-18 Apr. 1984_0 Ed: O.A.K.Al-

Erhayerm. Publ: Helsingor, Denmark; Ingeniorhojskolen Helsingor Teknikum; 1984. pp. 11-19. 6 fig.

Languages: English

+ English

Conventional and new techniques in welding and allied processes that give improved efficiency and productivity are reviewed. Techniques used with standard arc welding processes (e.g. MIG, MAG, submerged arc) to improve deposition ‘rates or allow welding of thick plate include hot or cold filler wire or metal powder addition, multiple electrode welding, narrow gap welding, combine processes and oscillating wire welding. High productivity surfacing methods include submerged arc strip cladding, plasma he wire surfacing and electroslag strip surfacing. New techniques described are: EB welding, laser welding, diffusion bonding, hi temperature brazing. Transistorised power sources for feedbac control of pulsed TIG welding are described. Automation is discussed for monitoring and feedback control of electrical parameters and seam tracking, as used by robots. The improved weldability of new steel grades has helped the advanced of automation. Developments in radiography, ultrasonic testing and acoustic emission monitoring for quality assurance in automated processes are also described.

6/5/5

107986

High deposition rate submerged arc welding with iron powder additions.

Natal Y.D.

Metalurgia ABM (Sao Paulo) Vol. 38, No. 296. July 1982. pp. 39 396. 13 fig., 5 tab., 9 ref.

Languages: Portuguese

+ Portuguese (Paper presented at 7th National Meeting on Weldir Technology, Belo Horizonte, Dec. 1981).

Submerged arc welds were prepared in 12 and 25 mm BS4360 grade 43A steel plate with iron powder additions, varying the polarity

of the electrode and using different particle sizes and amounts of powder. Results show an increase in deposition rate of 130% compared to conventional reverse polarity submerged arc welding. Improvements in bead shape and appearance at high current densities, better control of penetration, less distortion and ease in welding of imperfectly aligned joint preparations are also claimed. Data are presented showing effects of current on deposition rate, penetration, size of HAZ and dilut

6/5/6
107672
Submerged-arc welding with metal powder additions.
Eichhorn F.;Kerkmann M.
Industrie-Anzegiger Vol. 103, No. 54. 3 July 1981. pp. 46-48. 5 fig., 13 ref.
Languages: German
+ German
Investigations were conducted on a submerged-arc welding process in which the specially developed welding head allows the wire electrode to be covered with metal powder during welding. To aid analysis of the welding process, high speed X-ray photography was used. On the basis of promising experimental results, a series of comparison tests was carried out, using testpieces in 38 mm thick plates of St52-3 steel produced by (a) conventional techniques, (b) with metal powder additions at 12 kg/h and (c) with additions at 10 kg/h. The possible advantages of tandem and multiwire welding using this technique are still being researched.

6/5/7
107043
The selection of welding consumables and the development of welding procedures for steels for offshore constructions.
Dawson G. W.
In: Welding in Energy-Related Projects. Proceedings International Conference, Toronto, Canada, 20-21 Sept. 1983.

Publ: Willowdale, Ontario M2J 1P9, Canada; Pergamon Press; 1984. ISBN 0-08-025412-8. pp. 389-402. 13 fig., 1 tab., 5 ref.

Languages: English

+ English

The historical development and guidelines to selection are described for consumables and process procedures for obtaining optimum weld notch toughness (according to COD and Charpy V notch tests) in welds for offshore platforms in steels such as BS 4360: 50D. Recent MMA electrodes have thin basic coverings instead of cellulose coatings, increased manganese content,addition of 2.5%Ni, compositional changes to limit weld metal inclusion size or give controlled hydrogen ts. For submerged arc welding, basic agglomerated fluxes give best toughness and may be used with filler wire having 1.5% Mn or 2% Mn, and with iron powder addition. Cored filler wires with controlled levels of Mn, Si and Ni are recommended for MIG welding. The effects on toughness of weld bead size and weaving patterns, welding current, joint preparation (single or double V; preparation angle and electrode diameter),,, restraint, and backgouging are discussed.

6/5/8

102375

Recent developments in fusion welding.

Salter G. R.

Tn: Welding and the Engineer - The Challenge of the 80’s. Proceedings Joint International Conference, Pretoria, 1-3 Mar. 1983. Publ: Kempton Park 1620, South Africa; South African Institute of Welding; and Marshalltown 2107, South Africa; South African Institution of Mechanical Engineers; 1983. Vol. 1. Paper 2. pp. 1-26. 21 fig., 10 ref.

Languages: English

+ English

Several developments in fusion welding of materials greater than 3 mm in thickness are described. These include better control of arc welding processes (pulsed TIG and synergic MIG) by current

pulsing and by developments in solid state power sources, which leads to higher quality welds. Improved productivity has been achieved by using flux-cored wires, metal powder additions, e.g. in submerged arc welding, and narrow gap preparations. The increased use of mechanisation and robots has also improved productivity. Other developments described include power beam welding (electron beams and lasers). Future applications of these developments in several industries are discussed.

6/5/9
101147
High deposition rate submerged arc welding for critical applications.
Fraser R.; McLean A.; Webster D. J.; Taylor D. S.
In: Offshore Welded Structures. Proceedings 2nd International. Conference, London, 16-18 Nov. 1982. Director: H. C. Cotton. Publ: Abington, Cambridge CB1 6AL, England; Welding Institute; 1983. ISBN 0-85300-168-5. Session II. Paper 12. 15 pp. 16 fig., 13 tab., 14 ref.
Languages: English
+ English
Typical submerged arc welding procedures used by McDermott Ltd in the construction of offshore platforms from BS 4360 grade 50D steel plate of 50 mm thickness with SD3 wire and 0P121TT flux are described, and the development of an Ni-alloyed iron powder (0.04, 0.6%Mn, 2.6%Ni, 0.12%V) for adding to the molten pool to improve deposition rates (bulkwelding) is investigated. Factors influencing weld metal properties are reported for both the Ni-alloyed powder and for C-Mn powder additions, for both single wire and tandem wire procedures. Aspects covered include: weld metal compositions; Charpy V-notch data down to -40 deg. C; CTOD results at -10 deg. C; powder feed rates; role of vanadium; productivity; production experience; weld microstructure.

6/5/10
96521
Production increase by submerged arc welding with iron powder additions.
Baach H.
In: Eighth Conference on Welding. Proceedings Conference, Budapest, Hungary, 3-5 June 1980. Publ: Budapest, Hungary; Scientific Society of Mechanical Engineers; 1980; 11 pp.
Languages: German
Iron powder additions permit improved production rates and toughness without use of the expensive, complicated multiple wire systems. Direct powder addition allows single pass welds 30 mm thick to be produced. Jont configuration and operation condition are given for one and two wire systems. The use of powder containing Ti, boron and Mo results in a fine, tough structure a energy inputs of up to 400kJ/cm in steels 35 and 52-3.

6/5/11
96445
Submerged-arc welding with iron powder addition.
Kast W. H.; Baach H.
Zeitschrift fur Schweisstechnik/Jorunal de la Soudure Vol. 69, .No. 12. Dec. 1979. pp. 349-351, 3 fig., 2 tab.
Languages: German
Increased efficiency in submerged-arc welding is closely relate to the energy input range. This, in turn, has a critical influence on the microstructure in the weld metal and the heat-affected zone. Recently developed fine-grained steels, microalloyed with N and Ti, have allowed great improvements in th situation. The welding of these materials with modified flux-cored wires and iron powder additions using the submerged-arc technique is described.

6/5/12

94881

Possibilities of increasing the productivity and power efficiency in submerged arc welding.

Mosny J.; Malinovska E; Pavelka V.

In: Welding and Allied Processes Energy and Economy. Proceedings, Public Session, IIW Annual Assembly, Ljubljana, 6 Sept. 1982. Publ: Ljubljana, Yugoslavia; Institut za Varilstvo (for the IIW); 1982. Paper B5. 11 pp. 8 fig., 4 tab., 5 ref.

Languages: English

Some methods of submerged arc welding, e.g. welding with hot wire, welding with metal powder addition, parallel-wire welding and narrow gap welding, which provide the possibilities to increase deposition rate and at the same time the decrease of energy consumption, were characterised and compared. It was stated that energy redistribution occurred and the relative increase of the energy consumed for filler metal fusion could be observed. Data are presented indicating the relative productivity of the processes, and the effects of stick out, gap width, plate thickness and energy input on deposition rate are illustrated.

6/5/13

94760

Improvement of the low temperature toughness of single layer submerged arc welds by means of powder addition.

Mayer A. R.

Schweissen und Schneiden Vol. 34, No. 12. Dec. 1982, pp. 605-606.

Languages: German

Low temperature toughness, measured by notched impact energy, of welds made by submerged arc welding in ships' plate was investigated. Toughness was improved by addition of rare earth elements (Ce) by way of the welding flux. The microstructure of materials exhibiting imporved toughness was examined.

6/5/14
76862
The effects of chromium on the resistance of weld metal to hot cracking.
Leinachuk E. I.; Podgaetskii V. V.; Parfesso G. I.
Automatic Welding Vol 31,N0. 1 Jan. 1978. pp. 16018. 4 fig., 1 tab., 8 ref.
Languages: English
+ English translation of Avtomaticheskaya Svarka.
The effect of Cr (0-28%) on weld metal (WM) solidification cracking is examined in a series of controlled Mn experiments using submerged arc-welding with Cr-cored wires and 48-OF-6 flux with Cr powder additions. Occurrence of cracks is related to Wm Cr content: no cracks are present when the WM has the compositio 0.32 -O.34%C, 20.14024.3% Cr, 0.012 -0.015%S.
The effect of Cr on the WM microstructure and nature of non-metallic inclusions is examined. Sulphide inclusions become Cr enriched with increasing Cr content, and complex carbosulphides may form. The solidification structure may be affected with associated glassy and spinel type inclusions. Decreased resistance to cracking at higher Cr contents is associated with elongated grain boundary sulphides and carbosulphides.

6/5/15
66683
High deposition rate submerged-arc welding.
Reynolds D. E. H.
Submerged Arc Welding. Publ: Abington Cambridge CB1 6AL; Welding Institute; 1978. ISBN 085 300116 2. PP. 43-38. 5 fig., 1 tab.
Languages: English
English
Duty cycle and deposition rate, two principal factors affecting welding costs and applicable to all processes, are discussed. Submerged-arc welding with straight polarity (DC power), with the

negative side of the circuit connected to the electrode, is inexpensive and increases deposition rate. Using an increased electrical stickout on the welding wire a significant deposition rate increase can be achieved, metal powder additions to the joint give increased deposition rates, eliminate backgouging of butt welds and allow wide gap welding, e.g. heavy column sections on large buildings.

6/5/16
66470
Wire and (flux) powder combinations for submerged arc welding operations for container and reactor construction.
Zentner H.
Bander-Bleche-Rohre Vol. 19, No. 3, Mar. 1978, pp. 119-121.
Languages: German
German
Some factors in the choice of flux and wire or strip electrode materials for welding by the submerged arc process with powder additions are discussed in relation to the preparation of high duty welds in alloy steels for use in applications such as pressure vessels, fuel pipe lines, reactor construction, and similar parts. Some examples are discussed in relation to the specification requirements.

6/5/17
32898
Welding under powder with metal powder additions.
Eichhorn F.; Engel A.; Bachem P.
Blech Vol 18, No. 7. July 1971. pp. 273-277. 7 ref.
Languages: German
German
The submerged arc-welding of steel plate was investigated. Initial experiments with a water cooled mould to simulate the welding conditions were used to select the best weld material. Subsequent trials were made with steel plates, the edges to be

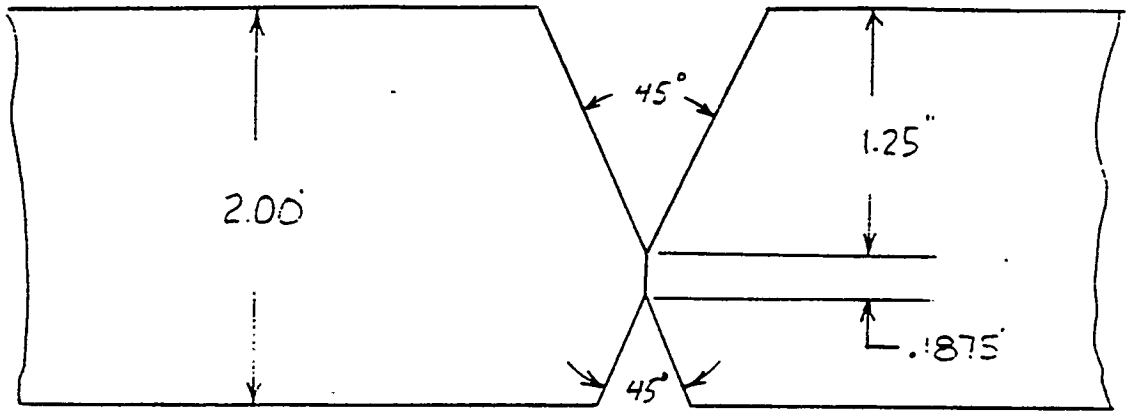
butt welded being chamfered to give a V. Metal powder in the supplemented the filler wire and a protective powder was used above the weld as well as below. The effect of amount of meta powder in the V and the angle of the V (30 or 60 deg.) on the welding current, welding speed, and notch-fracture toughness w assessed.

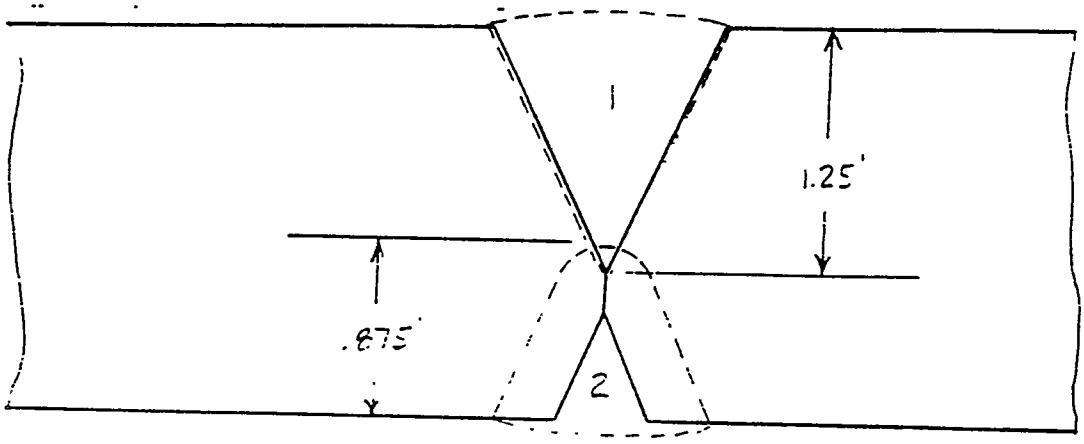
6/5/18
32799
A note on the examination and tests on welded joints subject to large stresses.
Granjon H.
Bull. Liaison Otua No. 3. 1972. pp. 7-10.
Languages: English
Examination and tests on samples .of niobium bearing steel A5 taken from the deck of a failed bridge. Base metal properties; multipass submerged arc welding with powder additions. Tensil tests, toughness and hardness measurements. Study of the weldability of this steel. Implant cracking tests.

APPENDIX C

JOINT VOLUME CALCULATIONS AND CONSUMABLES COST ESTIMATES FOR HY-80

Objective: The objective of this appendix is to establish joint volumes and consumables costs for two different joint designs using conventional SAW-AU, and compare those costs to the costs of consumables for the same two joint designs welded using SAW-AU with metal powder additions. Projections of consumables costs based on large scale purchases of metal powder are also presented.





CSA_1:T = 1.25"

A = 45°

RF,RO = 0

$.10(CSA_1)$ = Reinfcmt.

CSA_2:T = .875"

A = 45°

RF,RO = 0

R = .25

$.10(CSA_2)$ = Reinfcmt.

To determine cross sectional area ($CSA_{B2V.3}$)

$$CSA_{B2V.3} = CSA_1 + CSA_2 + .10(CSA_1) + .10(CSA_2)$$

$$= \left[(T-RF)^2 \tan \frac{A}{2} + RO \times T\right] + \left[(T-R-RF)^2 \tan \frac{A}{2} + 2R(T-R-RF) + \frac{1}{2}\pi R^2 + RO \times T\right] + .10(CSA_1) + .10(CSA_2)$$

(from Cary, "Modern Welding Technology")

$$= \left[(1.25)^2 \tan 22.5^\circ + 0\right] + \left[(.875-.25)^2 \tan 22.5^\circ + .5(.875-.25) + \frac{1}{2}\pi(.25)^2 + 0\right] + .10(CSA_1) + .10(CSA_2)$$

$$= .65in^2 + .57in^2 + .065in^2 + .057in^2$$

$$= 1.34\ in^2$$

To determine weight of weld metal per linear foot - B2v.3

$$1.34\ in^2 \times .283\ lbs/in^3 \times 12\ in = 4.55\ lbs\ per\ foot$$

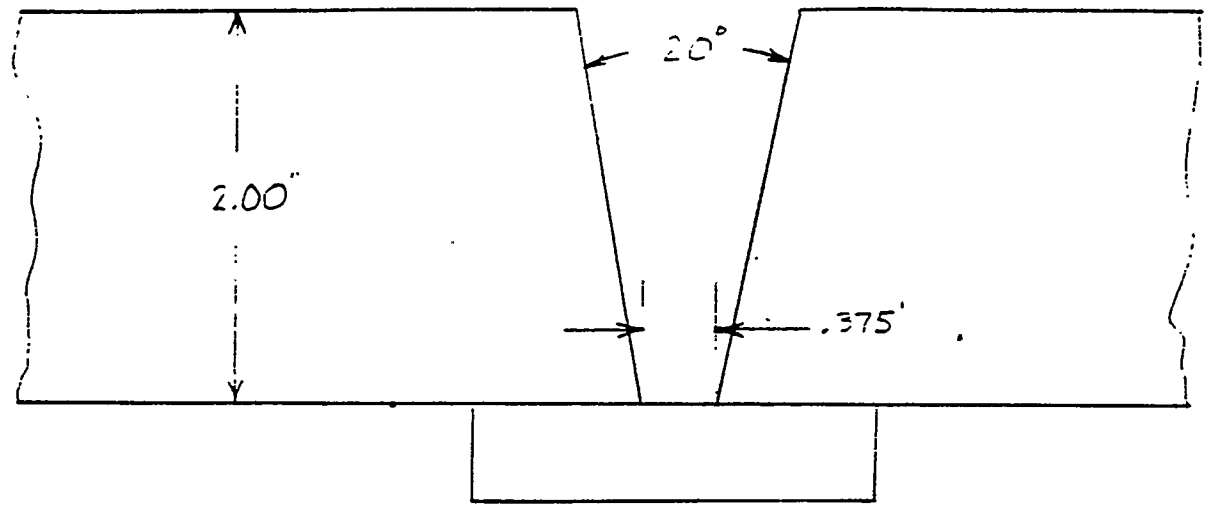
Cost of 1/8" MIL-100S-1	=	$1.08 per pound
Cost of MIL-100S-1F Flux	=	$ .32 per pound
Cost of M-2 Metal Powder	=	$2.000 per pound

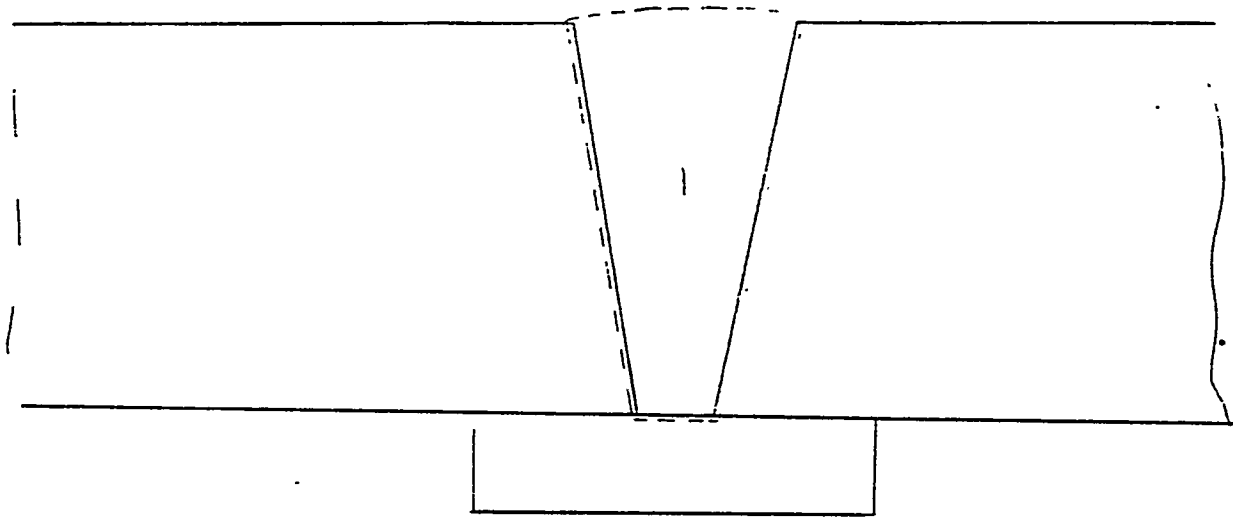
Current consumable cost of welding one foot with 1/8"SAW-AU and no powder for B2V.3:

4.55 lbs of MIL-100S-1	=	$4.91
4.55 lbs of MIL-100S-1F	=	1.46
		$6.37

Current consumable cost of welding one foot with 1/8" SAW-AU and M-2 metal powder @ 1:1:

2.28 lbs of MIL-100S-1	=	$2.46
2.28 lbs of MIL-100S-1F	=	.73
2.28 lbs of M-2	=	4.56
		$7.75





CSA_1: T = 2.0"

A = 20°

RF = 0

RO = .375"

.10(CSA_1)=Reinforcement

To determine cross sectional area ($CSA_{Blv.3}$)

$$CSA_{Blv.3} = CSA_1 + .10(CSA_1)$$

$$= \left[(T-RF)^2 \tan \frac{A}{2} + RO \times T\right] + .10(CSA_1)$$ (from Cary, "Modern Welding Technology")

$$= \left[(2-0)^2 \tan 10^\circ + .375 \times 2\right] + .10(CSA_1)$$

$$= 1.46 \text{ in}^2 + .15 \text{ in}^2$$

$$= 1.61 \text{ in}^2$$

To determine weight of weld metal per linear foot - BIV.3

$$1.61 \text{ in}^2 \times .283 \text{ lbs/in}^3 \times 12 \text{ in} = 5.47 \text{ lbs per foot}$$

Cost of 1/8" MIL-100S-1	=	$1.08 per pound
Cost of MIL-100S-1F Flux	=	$ .32 per pound
Cost of M-2 Metal Powder	=	$2.00 per pound

Current consumable cost of welding one foot with 1/8" filler wire and no powder for B1V.3:

5.47 lbs of MIL-100S-1	=	$ 5.91
5.47 lbs of MIL-100S-1F	=	1.75
		$ 7.66

Current consumable cost of welding one foot with 1/8" filler wire and M-2 metal powder @ 1:1 for B1V.3:

2.74 lbs of MIL-100S-1	=	$ 2.96
2.74 lbs of MIL-100S-1F	=	0.88
2.74 lbs of M-2	=	5.47
		$ 9.31

Assuming the cost of M-2 is reduced to 1.08 per pound: (the same as 1/8" MII 100S-1)

Cost of 1/8" MIL-100S-1	=	$1.08 per pound
Cost of MIL-100S-1F Flux	=	$ .32 per pound
Cost of M-2 Metal Powder	=	$1.08 per pound

Projected consumable cost of welding one foot with 1/8" filler wire, and no powder for B2V.3 (from page 1):

= $6.37

Projected consumable cost of welding one foot with 1/8" filler wire and M-2 metal powder @ 1:1 for B2V.3:

2.28 lbs of MIL-100S-1	=	$2.46
2.28 lbs of MIL-100S-1F	=	.73
2.28 lbs of M-2	=	2.46
		$5.65

Savings: $0.72 per foot

Projected consumable cost of welding one foot with 1/8" filler wire, and no powder for B1V.3 (from page 2):

= $7.66

Projected consumable cost of welding one foot with 1/8" filler wire, and M-2 metal powder @ 1:1 for B1V.3:

4.05 lbs of MIL-100S-1	=	$ 2.96
4.05 lbs of MIL-100S-1F	=	0.88
4.05 lbs of M-2	=	2.96
		$ 6.80

Savings: $0.86 per foot

APPENDIX D

WELDING DATA SHEETS

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method
interpass (max) N/A
measured by
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE VEC-8
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: (A) 5/32" LINDE MIL-A1 (B) OERLIKON M-13K
PO/Heat/Lot: 545-3511-R METAL POWDER
Specification: MIL-E-18193-B

TUNGSTEN: Type / Size / Other

BASE MAT'L:
Type Dimensions: 2' x 3' x 1" T
PO/Heat/Lot: N/R
Specification: MIL-S-16113 Gr HT

JOINT: Type B1V.2 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

VISUAL INSPECT: ___ Ground ___ As welded X Satisfactory ___ Unsatisfactory Procedure ___ Initial HMR

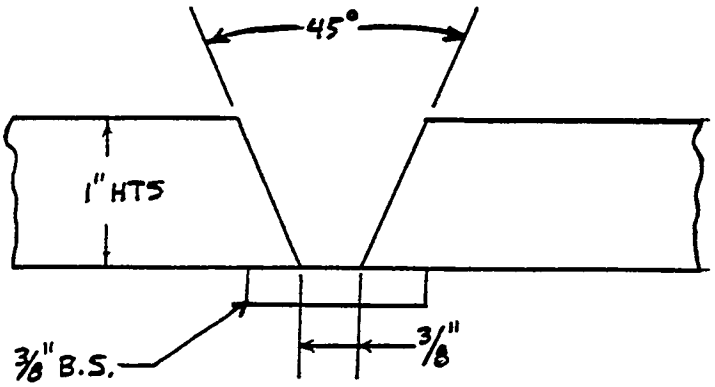
SHIELDING METHOD: Gas Mix ___ CFH; Flux LINCOLN 780; PO/Heat/Lot N/R

FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

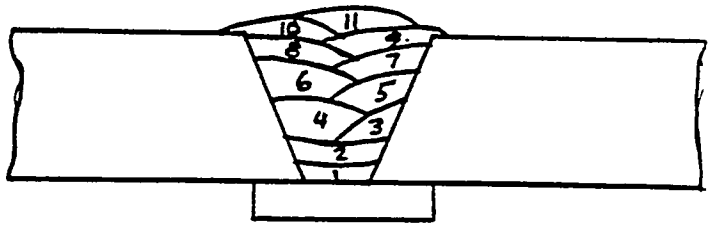
RT: X Accept ___ Reject Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

Comments:

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr M+r	Pwdr Dep.	NOTES
1	590-610	33/34	A/B	1 1/4"	23 ipm	42 ipm	6	14 #/hr	GOOD APPEARANCE
2	↓	↓	↓	↓	↓	↓	↓	↓	APPROX 31 #/hr
3-11	↓	↓	↓	↓	20 ipm	49 ipm	↓	↓	

Technician/SSN	Charge	Date	Joint No.
MECKLEY / MILLER	1026 M-15	6-18-84	M729-1

NN 4293 (REV 2)

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method
interpass (max) N
measured by
maximum interpass reach
___ Yes

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE VEC-8
Current: ___ AC X DCEP ___ DCEN

___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 5/32 LINDE MIL-A1 Ⓑ OERLIKON M-13K
PO/Heat/Lot: 545-3511-R METAL POWDER
Specification: MIL-E-18193-B

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HTS 2'x3'x1"T
PO/Heat/Lot: N/R
Specification: MIL-S-24113

JOINT: Type B1V.2 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag ___ Tilt ___

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

VISUAL INSPECT: ___ Ground ___ As welded X Satisfactory ___ Unsatisfactory Procedure ___ Initial HMR

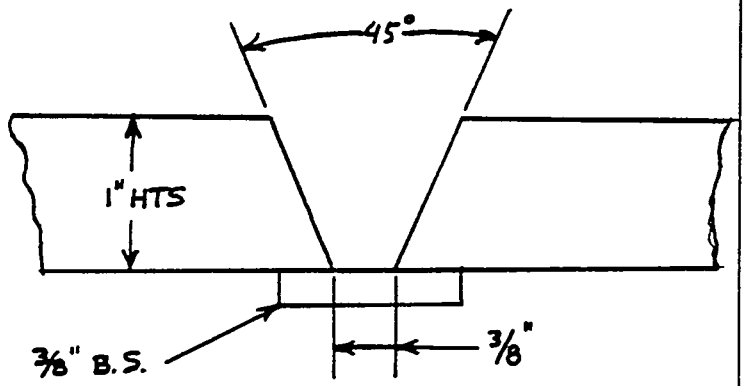
SHIELDING METHOD: Gas Mix ___ Flux LINCOLN 78 PO/Heat/Lot N/R

FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

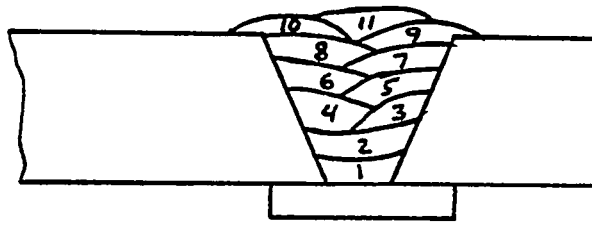
RT: X Accept ___ Reject Radiograph to: MIL-STD-271 Interpret to: 0900-003-9

Comments

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep	NOTES
1	400	30	A/B	1¼"	15 ipm	32 ipm	3	—	GOOD APPEARANC
2-11	↓	↓	↓	↓	↓	↓	↓		
									APPROX. 18 #/hr.

Technician/SSN	Charge	Date	Joint No.
MECKLEY / MILLER	1026M-15	6/19/84	M729

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuildi

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi~~ auto

POSITION: X 1 ___ 3 ___ 5 X ___ X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method ___
interpass (max) N/A
measured by ___
maximum interpass reached? ___ Yes ___

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE UEC-B
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 5/32" LINDE MIL-A1 | Ⓑ OERLIKON M-13K
PO/Heat/Lot: 545 - 3511-R | METAL POWDER
Specification: MIL-E-18193-B

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HTS 2'x3'x1"T
PO/Heat/Lot: N/R
Specification: MIL-S-24113

JOINT: Type BIV.2 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

VISUAL INSPECT: ___ Ground ___ As welded X Satisfactory ___ Unsatisfactory Procedure ___ Initial HMR

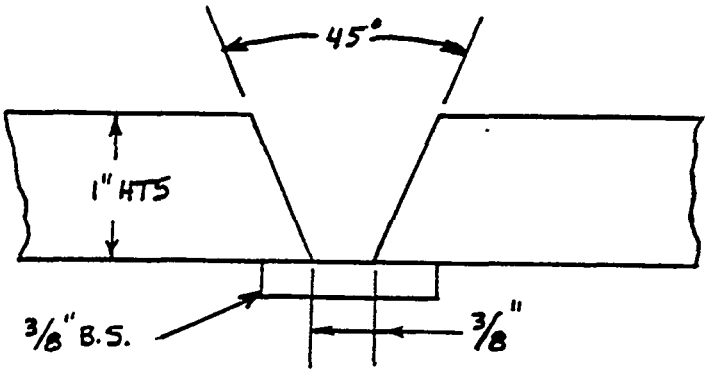
SHIELDING METHOD: Gas Mix ___ Flux LINCOLN 780 PO/Heat/Lot N/R

FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

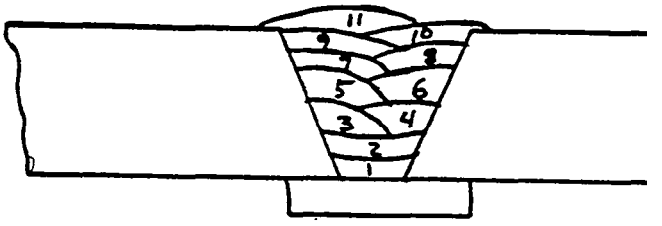
RT: X Accept ___ Reject Radiograph to: MIL-STD-271 Interpret to: 0900-003-900

Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Puddle Mtr.	Puddle Dep	NOTES
1	800	38/42	A/B	1¼"	30 ipm	67 ipm	11	27 #/hr	SLAG DIFFICULT TO RE
2	↓	↓	↓	↓	↓	↓	↓	↓	"
3	800	40/42	A/B	↓	↓	↓	↓	↓	GOOD APPEARANCE
4-11	↓	↓	↓	↓	↓	↓	↓	↓	
									APPROX. 60#/hr.

Technician/SSN	Charge	Date	Joint No.
MECKLEY / MILLER	1026M-15	6-19-84	M729-3

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shi
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N
method
interpass (max) N
measured by
maximum interpass reac
___ Yes

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE UEC-B
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 5/32" LINDE MIL-A1 | Ⓑ GERLIKON M-13K
PO/Heat/Lot: 545 - 3511-R | METAL POWDER
Specification: MIL-E-18193-R

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HTS 2'x3'x1"T
PO/Heat/Lot: N/R
Specification: MIL-S-24113

JOINT: Type BIV. 2 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag ___ Tilt ___

BACKSIDE PREP/NDT: ___ Ground ___ MT ___ Satisfactory ___ Gouged ___ PT ___ Unsatisfactory Procedure ___ Initial ___

VISUAL INSPECT: ___ Ground X Satisfactory ___ As welded ___ Unsatisfactory Procedure ___ Initial HMR

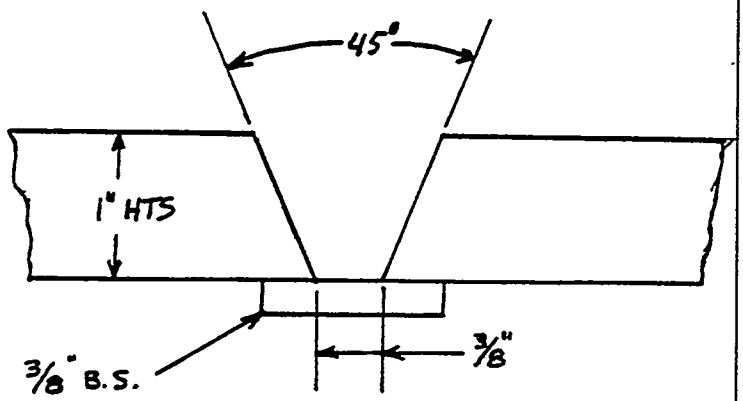
SHIELDING METHOD: Gas Mix ___ Flux LINCOLN PO/Heat/Lot ___

FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

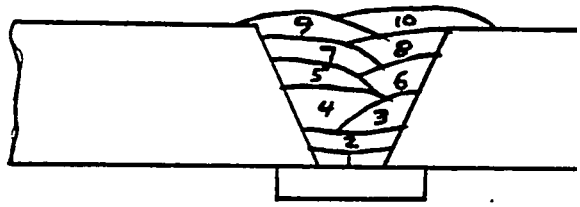
RT: X Accept ___ Reject Radiograph to: MIL-STD-271 Interpret to: 0900-003-

Comments

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1	700	35	A/B	1 1/4"	25 ipm	55 ipm	9	22 #/hr	SLAG DIFFICULT TO
2	↓	↓	↓	↓	↓	↓	↓	↓	"
3 - 10	↓	↓	↓	↓	↓	↓	↓	↓	GOOD APPEARANCE
									APPROX 37 #/

Technician/SSN	Charge	Date	Joint No.
MECKLEY / MILLER	1026M-15	6-20-84	M729

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi~~ auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method ___
interpass (max) N/A
measured by ___
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE VEC-8
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 5/32" LINDE MIL-A1
PO/Heat/Lot: 545 - 3511 - R
Specification: MIL-E-18193-B

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HTS 2'x3'x1"T
PO/Heat/Lot: N/R
Specification: MIL-S-24113

JOINT: Type BIV.2 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

VISUAL INSPECT: ___ Ground ___ As welded X Satisfactory ___ Unsatisfactory Procedure ___ Initial HMR

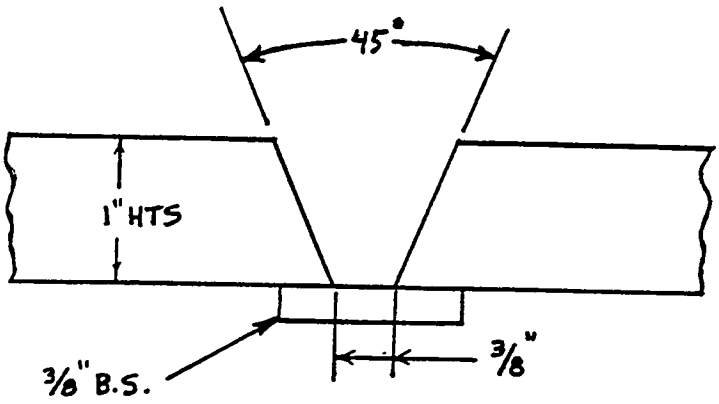
SHIELDING METHOD: Gas Mix ___ CFH; Flux LINCOLN 780; PO/Heat/Lot N/R

FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

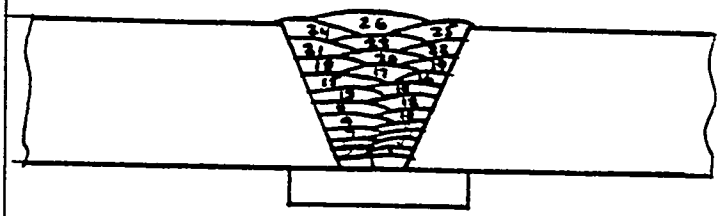
RT: X Accept ___ Reject Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED		NOTES
1	400	30	A	1 1/4"	15 ipm	33 ipm		SLAG DIFFICULT TO REMOVE
2	↓	↓	↓	↓	↓	↓		GOOD APPEARANCE
3-26	↓	↓	↓	↓	↓	↓		
								APPROX. 14.3 #/hr.

Technician/SSN	Charge	Date	Joint No.
MILLER	1026M-15	6/25/84	M729-5

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilc ng
A [illegible] company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method
interpass (max) N/A
measured by
maximum interpass reached?
___ Yes ___ [illegible]

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE UEC-8
Current: ___ AC X DCEP ___ DCEN

___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 5/32" LINDE MIL-A1 | Ⓑ OERLIKON M-13K
PO/Heat/Lot: 545 - 3511-R | METAL POWDER
Specification: MIL-E-18193B

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HTS 2'x3'x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-24113

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ✓ Ground ✓ Gouged ✓ MT ___ PT ✓ Satisfactory ___ Unsatisfactory
Procedure U23/123 Initial JAM

VISUAL INSPECT: ___ Ground ___ As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

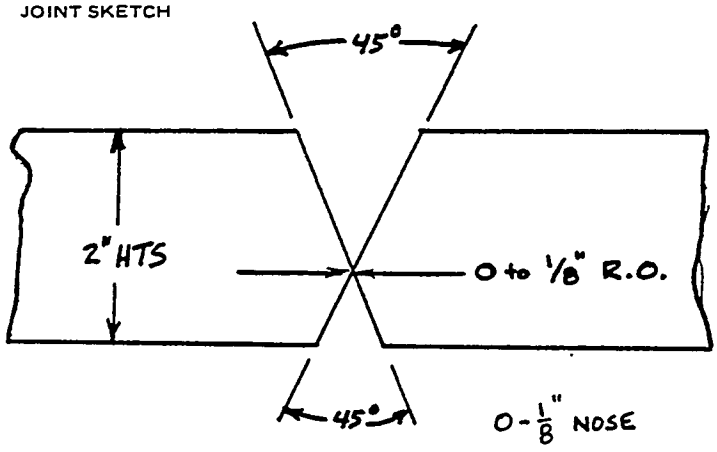
SHIELDING METHOD: Gas Mix ___ CF
Flux LINCOLN 780
PO/Heat/Lot N/R

FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory
Procedure ___ Initial ___

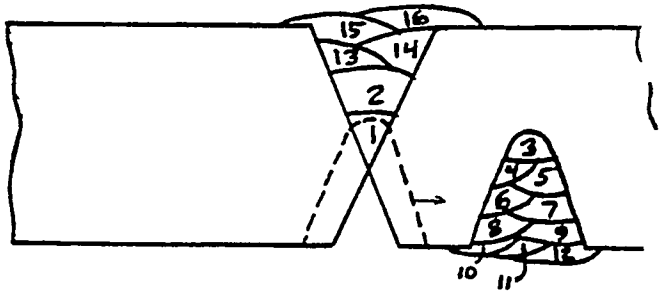
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000

Comments

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr.	Pwdr Dep.	NOTES
1	600	34	A/B	1 1/4"	20 ipm	50 ipm	—	17 #/hr	SLAG DIFFICULT TO REMOV
2-16	↓	↓	↓	↓	↓	↓	—	↓	GOOD APPEARANCE
									APPROX. 21 #/hr

Technician/SSN	Charge	Date	Joint No.
BLAIR	1026M-15	7/6/84	M729-9

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuildi
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method
interpass (max) N/A
measured by
maximum interpass reached? ___ Yes ___

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE VEC-8
Current: ___ AC X DCEP ___ DCEN ___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 5/32" LINDE MIL-A1 Ⓑ OERLIKON M-13K
PO/Heat/Lot: 545 - 3511-R METAL POWDER
Specification: MIL-E-18193-B

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HTS 2'x3'x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-24113

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ✓ Ground ✓ Gouged ✓ MT ___ PT ✓ Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial TES

VISUAL INSPECT: ___ Ground ___ As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

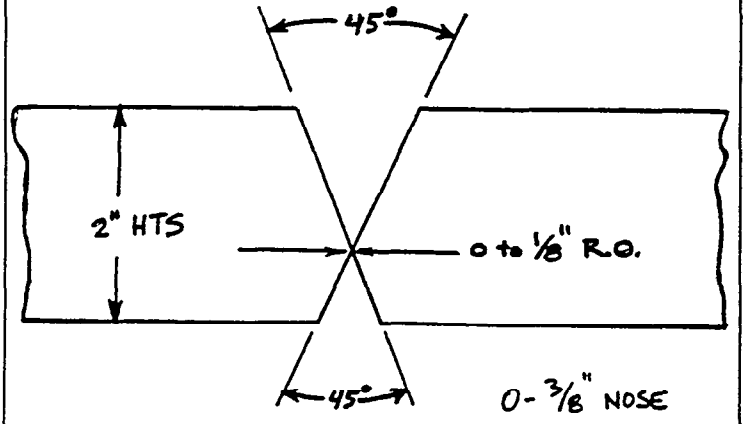
SHIELDING METHOD: Gas Mix ___ Flux LINCOLN 780 PO/Heat/Lot N/R

FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory
Procedure ___ Initial ___

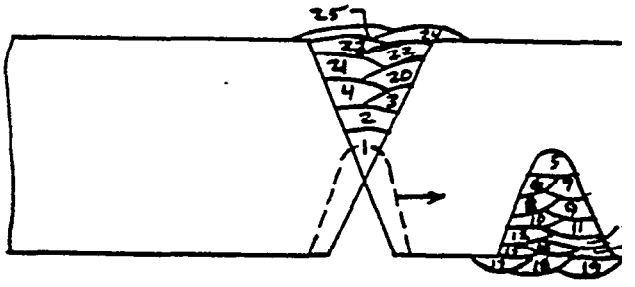
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-900

Comments

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mix	Pwdr Dep	NOTES
1	400	32	A/B	1 1/4"	15 ipm	32 ipm	—	6 #/hr	SLAG DIFFICULT TO REM
2-25	↓	↓	↓	↓	↓	↓	—	↓	GOOD APPEARANCE
									APPROX. 22 #/hr.

Technician/SSN	Charge	Date	Joint No.
BLAIR	1026M-15	7/12/84	M729 - 10

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuild

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi~~ auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method
interpass (max) N/A
measured by
maximum interpass reached? ___ Yes ___

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE UEC-8
Current: ___ AC X DCEP ___ DCEN ___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: (A) 5/32" LINDE MIL-A1 (B) OERLIKON M-13K
PO/Heat/Lot: 545-3511-R METAL POWDER
Specification: MIL-E-18193B

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HTS 2'x3'x1"T
PO/Heat/Lot: N/R
Specification: MIL-S-24113

JOINT: Type BIV.2 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

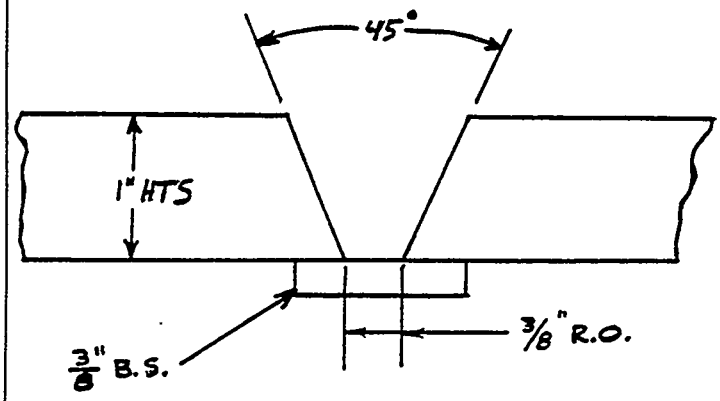
VISUAL INSPECT: ___ Ground ___ As welded X Satisfactory ___ Unsatisfactory Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ Flux LINCOLN 780 PO/Heat/Lot N/R

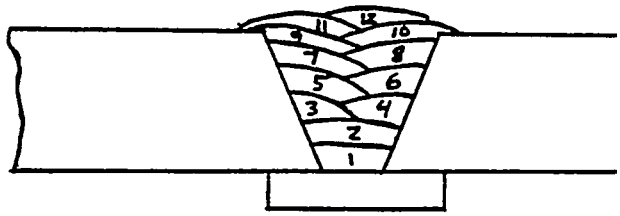
FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

RT: X Accept ___ Reject Comments ___ Radiograph to: MIL-STD-271 Interpret to: 0900-003-900

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep	NOTES
1	400	30/32	A/B	1 1/4"	15 ipm	N/R	—	3 #/hr	
2-12	↓	↓	↓	↓	↓	↓	—	↓	GOOD APPEARANCE
									APPROX 14 #/hr.

Technician/SSN	Charge	Date	Joint No.
BLAIR	1026M-15	7/17/84	M729-11

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS
___ SMAW ___ GMAW X SAW ___ manual
___ GTAW ___ FCAW ___ OTHER X auto

POSITION
X 1 ___ 3 ___ 5 X G X plate
___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method
interpass (max) N/A
measured by
maximum interpass reached?
___ Yes ___ No

EQUIPMENT
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE VEC-8
Current: ___ AC X DCEP ___ DCEN

___ AC ___ DCEP ___ DCEN

FILLER MAT'L
Size/Brand/Type: Ⓐ 5/32" LINDE MIL-A1
PO/Heat/Lot: 545 - 3511-R
Specification: MIL-E-18193B

Ⓑ CERLIKON M-13K METAL POWDER

TUNGSTEN
Type
Size
Other

BASE MAT'L
Type Dimensions: HTS 2'x3'x1"T
PO/Heat/Lot: N/R
Specification: MIL-S-24113

JOINT
Type BIV.2
Avg Bead/Lgth 36"

TORCH ANGLE
Lead/Lag 0°
Tilt 0°

BACKSIDE PREP/NDT
___ Ground ___ MT ___ Satisfactory
___ Gouged ___ PT ___ Unsatisfactory
Procedure ___ Initial ___

VISUAL INSPECT
___ Ground X Satisfactory
___ As welded ___ Unsatisfactory
Procedure ___ Initial HMR

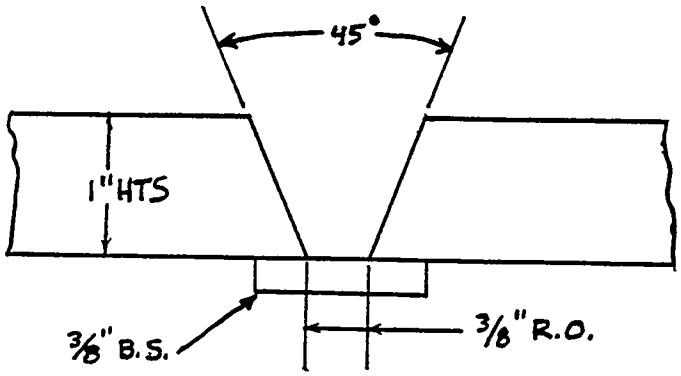
SHIELDING METHOD
Gas Mix ___ CFH
Flux LINCOLN 780
PO/Heat/Lot N/R

FINAL NDT
___ MT ___ Satisfactory
___ PT ___ Unsatisfactory
Procedure ___ Initial ___

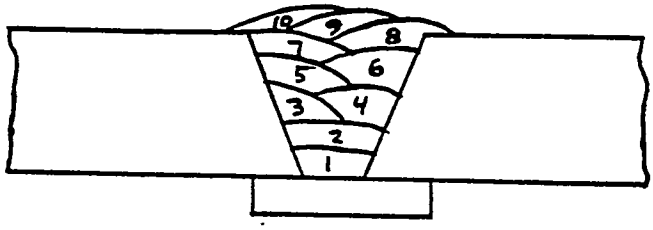
RT
X Accept
___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

Comments

JOINT SKETCH



BEAD PLACEMENT



PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powdr Mtr	Powdr Dep	NOTES
1-2	400	30	A/B	1 1/4"	15 ipm	N/R	—	3 #/hr	
3-10	600	36	↓	↓	21 ipm	↓	—	8 #/hr	GOOD APPEARANCE
									APPROX. 34 #/hr.

Technician/SSN	Charge	Date	Joint No.
SIMMONDS	1026M-15	7-24-84	M729-12

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi-~~ auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method
interpass (max) N/A
measured by
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE UEC-8
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 5/32" LINDE MIL-A1 / Ⓑ OERLIKON M-13K
PO/Heat/Lot: 545-3511-R / METAL POWDER
Specification: MIL-E-18193B

TUNGSTEN: Type / Size / Other

BASE MAT'L:
Type Dimensions: HTS 2'x3'x1"T
PO/Heat/Lot: N/R
Specification: MIL-S-24113

JOINT: Type BIV.2 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

VISUAL INSPECT: ___ Ground ___ As welded X Satisfactory ___ Unsatisfactory Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH; Flux LINCOLN 780; PO/Heat/Lot N/R

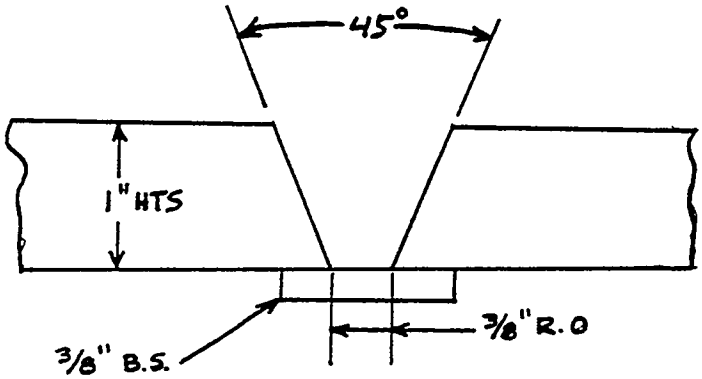
FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

RT: ___ Accept X Reject

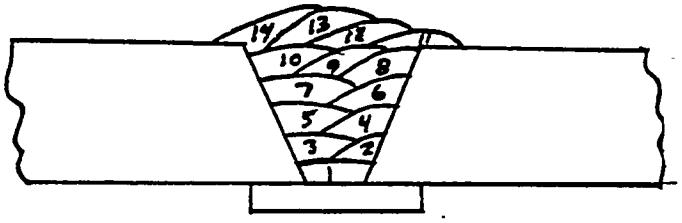
Comments: SLAG & THIN SHIM

Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

JOINT SKETCH



BEAD PLACEMENT



PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep	NOTES
1-3	400	30	A/B	1 1/4"	15 ipm	N/R	—	3 #/hr	
4-14	800	39/40	↓	↓	30 ipm	N/R	—	14 #/hr	GOOD APPEARANCE
									APPROX. 40 #/hr.

Technician/SSN	Charge	Date	Joint No.
SIMMONDS	1026M-15	7-28-84	MT29-13

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT: Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE UEC-8
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L: Size/Brand/Type: Ⓐ 1/8" MIL-100S-1 Ⓑ OERLIKON M-2
PO/Heat/Lot: N/R METAL POWDER
Specification: MIL-E-23765

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L: Type Dimensions: HY-80 2"x3"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial PB

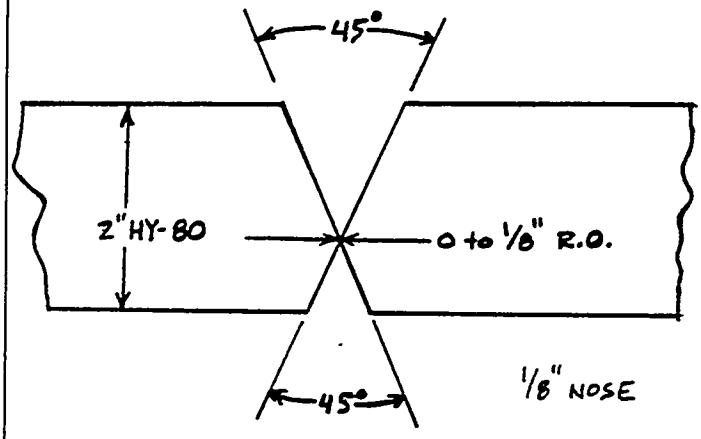
VISUAL INSPECT: X Ground ___ As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux OPIZI TI
PO/Heat/Lot N/R

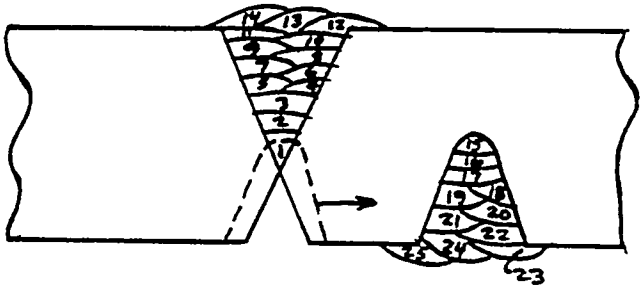
FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N/23/123 Initial JAM

RT: X Accept ___ Reject
Radiograph to: 271D
Comments ___
Interpret to: 0900-003-9000 CL1

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-2	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
3-14	670	32	A/B		26 ipm	N/R	7.5	—	1:1 POWDER-TO-WIRE
15	500	30	A		20 ipm	N/R	—	—	
16-25	670	32	A/B	↓	26 ipm	N/R	7.5	—	GOOD APPEARANCE

Technician/SSN	Charge	Date	Joint No.
HASKINS	1026M-15	10-2-84	M729-16

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi~~ auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE UEC-8
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON M-2
PO/Heat/Lot: N/R METAL POWDER
Specification: MIL-E-23765

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 19"x33"x2"
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 33"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged; X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial GHB

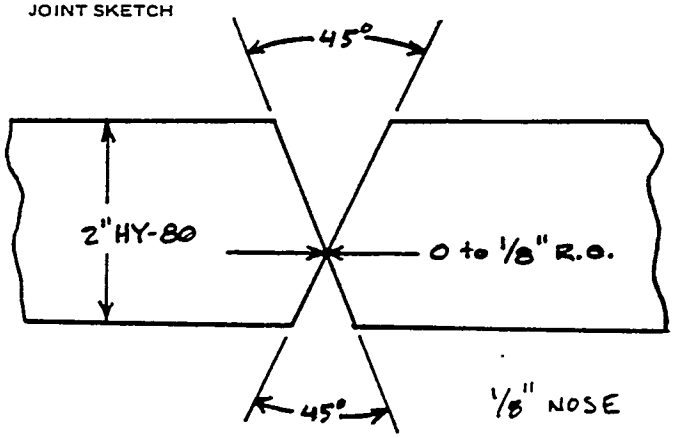
VISUAL INSPECT: X Ground ___ As welded; X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH; Flux OP 121 TT; PO/Heat/Lot ___ N/R

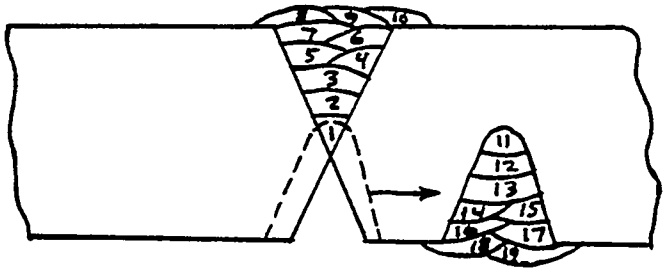
FINAL NDT: X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial DDM

RT: X Accept ___ Reject
Radiograph to: 271D
Comments ___
Interpret to: 0900-003-9000 CL

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep	NOTES
1-2	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
3-10	680	34	A/B	1 1/4"	26 ipm	N/R	—	9	1.25:1 POWDER-TO-WIRE
11-13	500	30	A	1 1/4"	20 ipm	N/R	—	—	
14-19	680	34	A/B	1 1/4"	26 ipm	N/R	9	—	

Technician/SSN	Charge	Date	Joint No.
HASKINS	1026M-15	10-16-84	M729-17

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE UEC-8
Current: ___ AC X DCEP ___ DCEN ___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON M-2
PO/Heat/Lot: N/R METAL POWDER
Specification: MIL-E-23765

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial DDM

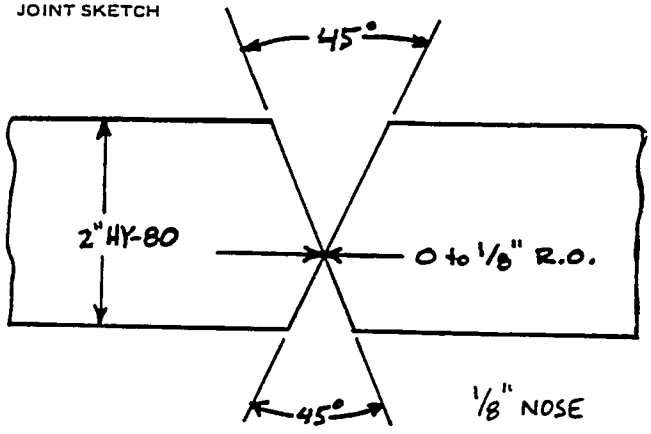
VISUAL INSPECT: X Ground ___ As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH; Flux OP121TT; PO/Heat/Lot N/R

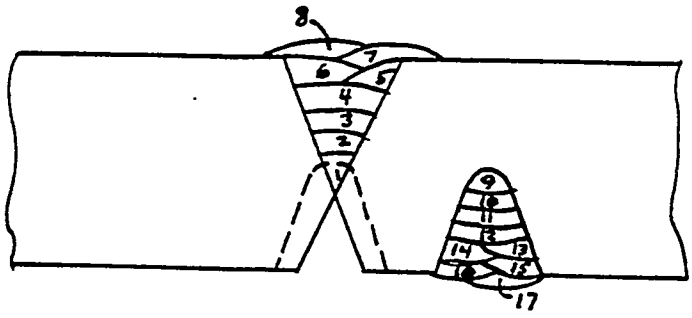
FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial DDM

RT: ___ Accept X Reject
Radiograph to: Z71D
Comments: SLAG TRAPPED AT FUSION LINE
Interpret to: 0900-003-9000 CL1

JOINT SKETCH



BEAD PLACEMENT



PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep	NOTES
1-2	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
3-8	500	34	A/B	1 1/4"	12 ipm	N/R	5	—	1:1 POWDER-TO-WIRE
9-10	500	30	A	1 1/4"	20 ipm	N/R	—	—	
11-17	500	34	A/B	1 1/4"	12 ipm	N/R	5	—	

Technician/SSN	Charge	Date	Joint No.
HASKINS	1026M-15	10-23-84	M729-18

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE UEC-8
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON M2
PO/Heat/Lot: N/R METAL POWDER
Specification: MIL-E-23765

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type B2V.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial LHB

VISUAL INSPECT: X Ground ___ As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

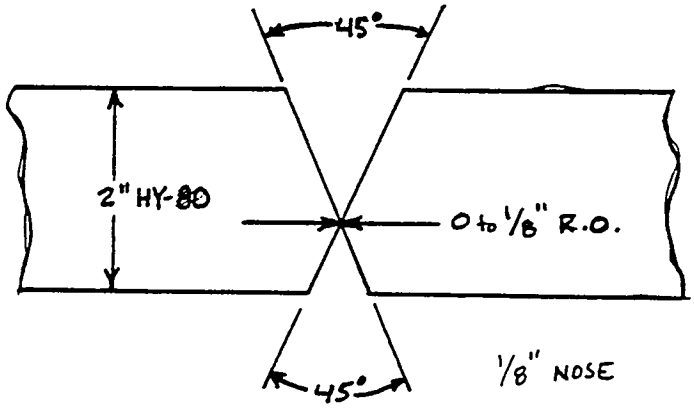
SHIELDING METHOD: Gas Mix ___ CFH; Flux OP 121 TT; PO/Heat/Lot N/R

FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial JAM

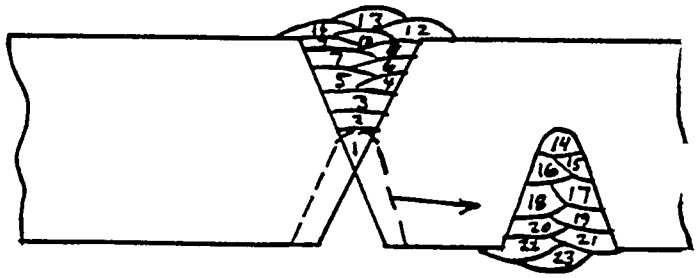
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

Comments: ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH - 13/16" - ___"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Puddle Mtr	Puddle Dep.	NOTES
1-2	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
3-13	680	34	A/B	1 1/4"	26 ipm	90 ipm	9	—	1:1 POWDER-TO-WIRE
14	500	30	A	1 1/4"	20 ipm	N/R	—	—	APPROX. 22 #/hr.
15-23	680	34	A/B	1 1/4"	26 ipm	90 ipm	9	—	

Technician/SSN	Charge	Date	Joint No.
HASKINS/MENSER	1026M-15	10-29-84	M729-19

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE VEC-8
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: (A) 1/8" LINDE MIL-100S-1 (B) OERLICON M2
PO/Heat/Lot: P545-3492R/095135/03P01D4 METAL POWDER
Specification: MIL-E-23765

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV-3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged; X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial LHB

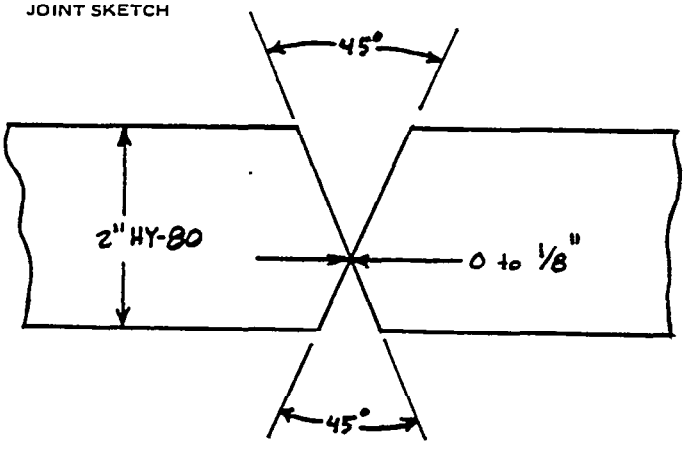
VISUAL INSPECT: X Ground ___ As welded; X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH; Flux OP 121 TT; PO/Heat/Lot ___ N/R

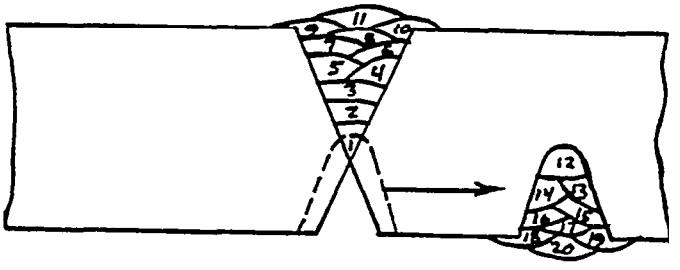
FINAL NDT: X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial JES

RT: X Accept ___ Reject
Comments ___
Radiograph to: MIL-STD-271 Interpret to: 0700-003-9000 Cl 1

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 13/

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1	500	30	A	1 1/4"	20 ipm	70 ipm	—	—	NO POWDER IN ROOT
2-11	680	34	A/B	1 1/4"	26 ipm	94 ipm	9.6	—	1.25:1 POWDER-TO-WIRE
12	500	30	A	1 1/4"	20 ipm	70 ipm	—	—	APPROX. 28#/hr
13-20	680	34	A/B	1 1/4"	26 ipm	94 ipm	9.6	—	

Technician/SSN	Charge	Date	Joint No.
MENSER	1026M-15	11-8-84	M729-20

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE UEC-8
Current: ___ AC X DCEP ___ DCEN / ___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON M2
PO/Heat/Lot: P545-3492R/095135/03P01DH METAL POWDER
Specification: MIL-E-23765

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial PB

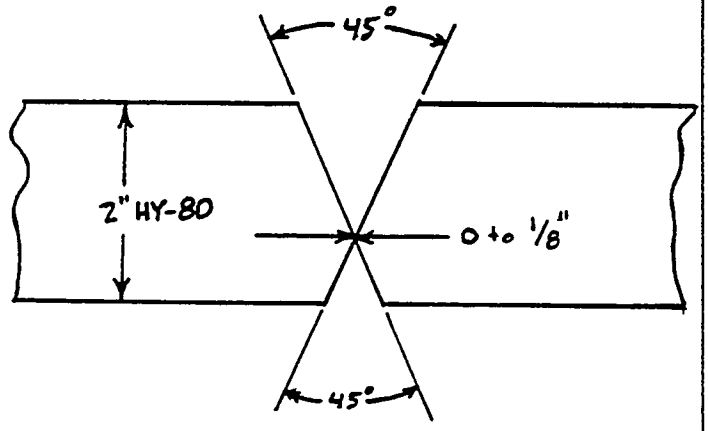
VISUAL INSPECT: X Ground ___ As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH; Flux OP 121 TT; PO/Heat/Lot ___ N/R

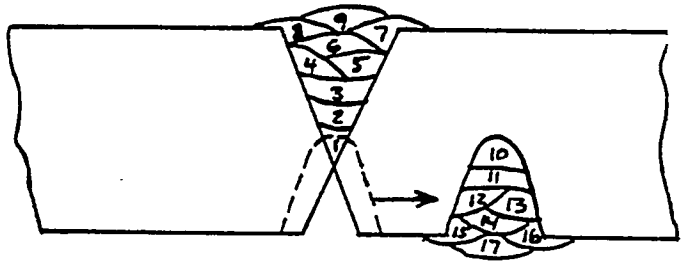
FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial LHB

RT: X Accept ___ Reject
Comments ___
Radiograph to: MIL-STD-271 Interpret to: 0200-003-9000 CL1

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 15/16"

PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1	500	30	A	1 1/4"	20 ipm	70 ipm	—	—	NO POWDER IN ROOT
2-9	680	34	A/B	1 1/4"	26 ipm	96 ipm	11.4	—	1.5:1 POWDER-TO-WIRE
10	500	30	A	1 1/4"	20 ipm	70 ipm	—	—	APPROX. 25 #/hr
11-17	680	34	A/B	1 1/4"	26 ipm	96 ipm	11.4	—	

Technician/SSN	Charge	Date	Joint No.
MENSER	1026M-15	11-15-84	M727-21

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA3S
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON MZ
PO/Heat/Lot: P545-3585-R / 095171 METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x2"T
PO/Heat/Lot: HO 16013119
Specification: MIL-S-16216

JOINT: Type B2V.3 Avg Bead/Lgth 42"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23 Initial TES

VISUAL INSPECT: ___ Ground ___ As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

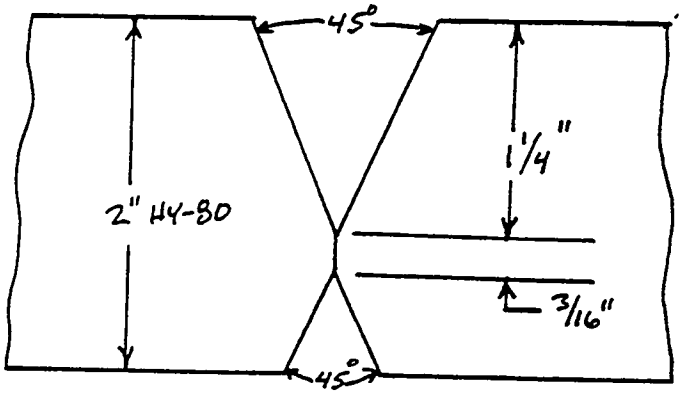
SHIELDING METHOD: Gas Mix ___ CFH
Flux OPIZITT
PO/Heat/Lot N/R

FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23 Initial JAM

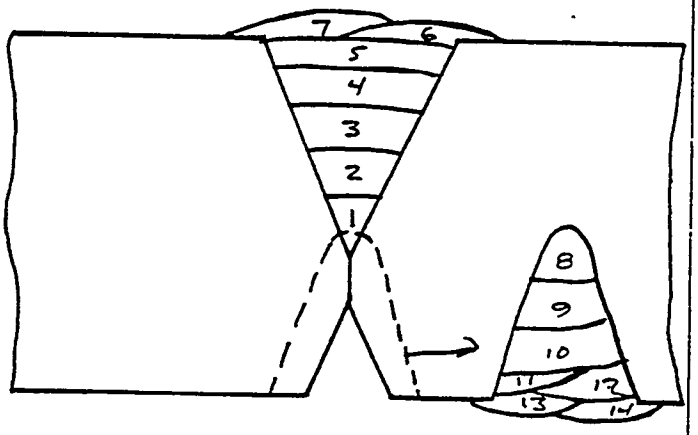
RT: ___ Accept X Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000CL1

Comments ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powder Mfr	Powder Dep	NOTES
1-2	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
3-5			A/B		12 ipm		7.2	—	1.25:1 POWDER-TO-WIRE
6-8			A				—	—	APPROX. 27 #/hr.
9-12			A/B				7.2	—	
13-14			A				—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	4-24-85	M729-24

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: MILLER SRS-1000
Torch/gas cup/wire feeder: LINDE VEC-8
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON M2
PO/Heat/Lot: P54S-35B5-K/045171 METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2"x3"x2'4"
PO/Heat/Lot: H.O. 16013119
Specification: MIL-S-16216

JOINT: Type BEV.3 Avg Bead/Lgth 38"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X MT X Satisfactory; X Gouged ___ PT ___ Unsatisfactory
Procedure N23 Initial JAM

VISUAL INSPECT: ___ Ground X Satisfactory; ___ As welded ___ Unsatisfactory
Procedure ___ Initial HMR

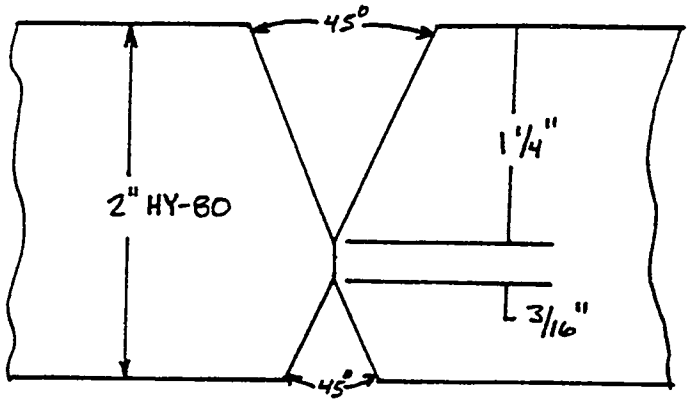
SHIELDING METHOD: Gas Mix ___ CFH
Flux OP121TT
PO/Heat/Lot ___ 11040

FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23 Initial JAM

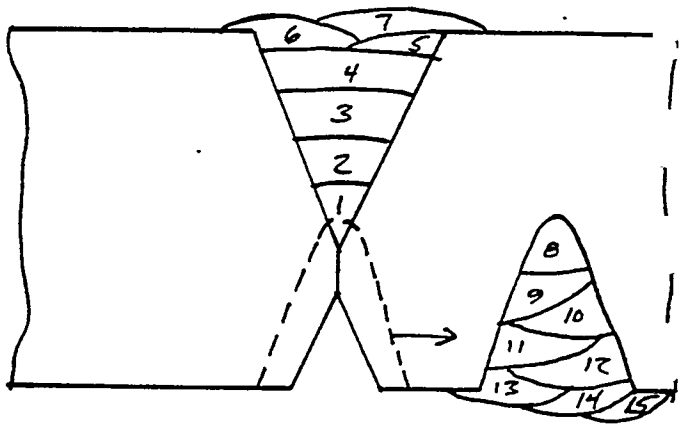
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271D Interpret to: 0900-003-9000C1

Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powder Mtr	Powder Dep	NOTES
1-2	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
3-7			A/B		12 ipm		6	—	
8			A				—	—	
9-15			A/B				6	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	4-9-85	M729-22

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 | Ⓑ OERLIKON M2
PO/Heat/Lot: 545-3585-K/0H3171 | METAL POWDER
Specification: MIL-E-23765 | LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2"x3"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type B2V.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Groun. X Gouged X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial JAM

VISUAL INSPECT: ___ Ground X As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

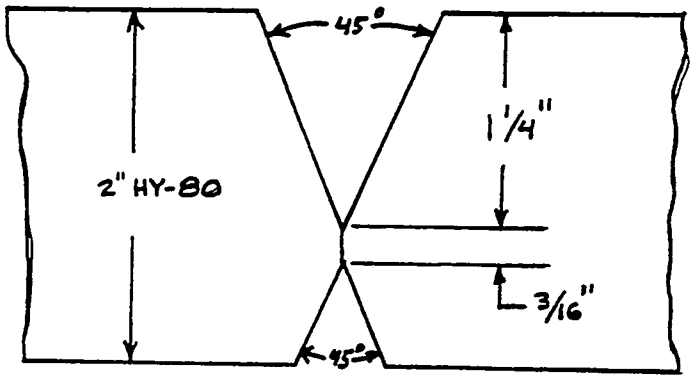
SHIELDING METHOD: Gas Mix ___ CFH
Flux OP 121 TT
PO/Heat/Lot ___ N/R

FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial JAM

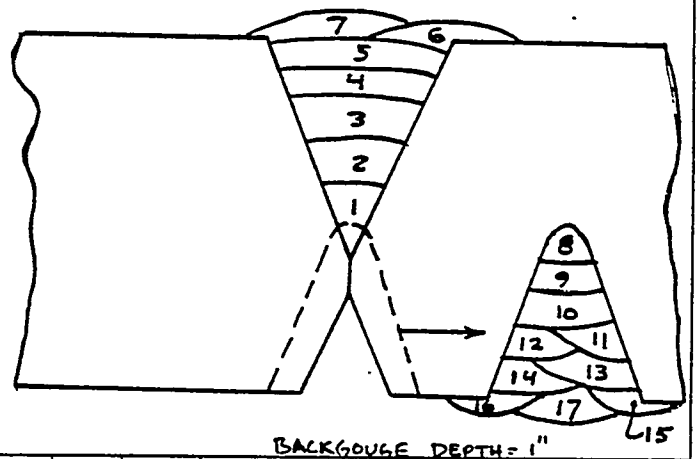
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

Comments ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mkr	Pwdr Dep.	NOTES
1-2	500	30	A	1¼"	20 ipm	N/R	—	—	NO POWDER IN ROOT
3-7	500	34	A/B	1¼"	12 ipm	N/R	4.2	—	.75:1 POWDER-TO-WIRE
8	500	34	A	1¼"	12 ipm	N/R	—	—	APPROX .22 #/hr
9-17	500	34	A/B	1¼"	12 ipm	N/R.	4.2	—	

Technician/SSN	Charge	Date	Joint No.
B. A. STINSON	1026M-15	4-7-85	M729-26

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON M2
PO/Heat/Lot: P545-34848/095119 METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type B2V.3 Avg Bead/Lgth 3/16"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial LHB

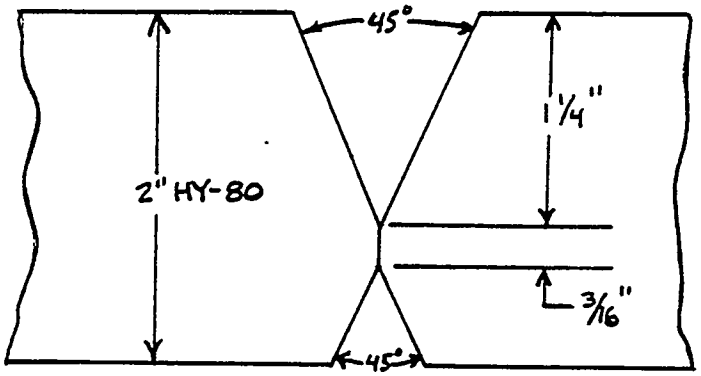
VISUAL INSPECT: X Ground ___ As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux OP 121 TT
PO/Heat/Lot N/R

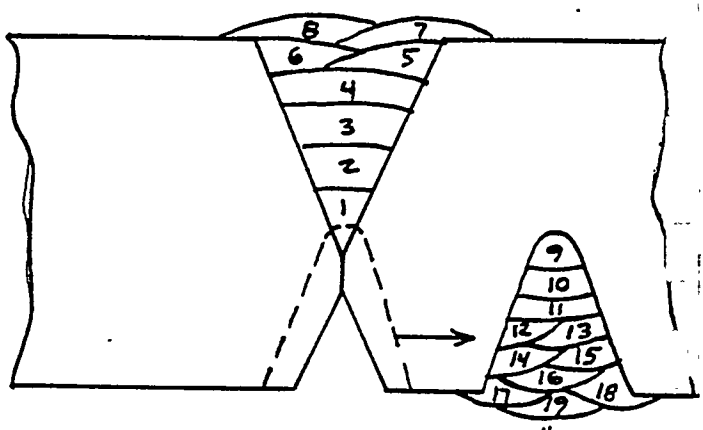
FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial KRF

RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL
Comments ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-2	500	30	A	1¼"	20 ipm	70 ipm	—	—	NO POWDER IN ROOT
3-7	680	34	A/B	1¼"	26 ipm	N/R	9.8	—	GOOD APPEARANCE
8	500	30	A	1¼"	20 ipm	70 ipm	—	—	
9-16	680	34	A/B	1¼"	26 ipm	N/R	9.8	—	
17-19	500	34	A	1¼"	20 ipm	N/R	—	—	

Technician/SSN: B.A. STINSON
Charge: 1026M-15
Date: 4-29-85
Joint No.: M729-27

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi~~ auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN ___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON M2
PO/Heat/Lot: P545-3484B/095119 METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-100 2"x3"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X MT X Satisfactory; X Gouged ___ PT ___ Unsatisfactory
Procedure N23/123 Initial KRF

VISUAL INSPECT: ___ Ground X Satisfactory; X As welded ___ Unsatisfactory
Procedure ___ Initial HMR

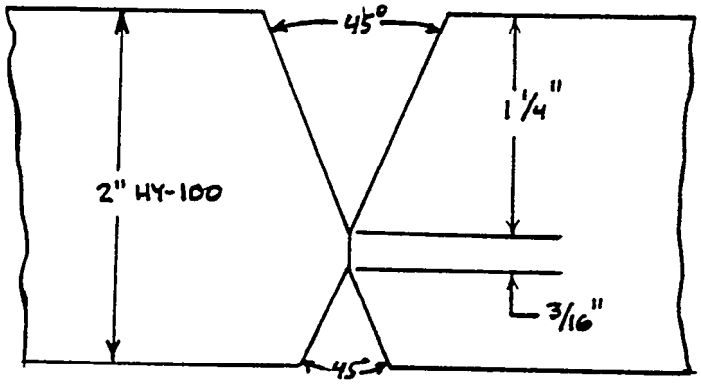
SHIELDING METHOD: Gas Mix ___ CFH
Flux OPIZITT
PO/Heat/Lot ___ N/R

FINAL NDT: X MT X Satisfactory; ___ PT ___ Unsatisfactory
Procedure N23/123 Initial PB

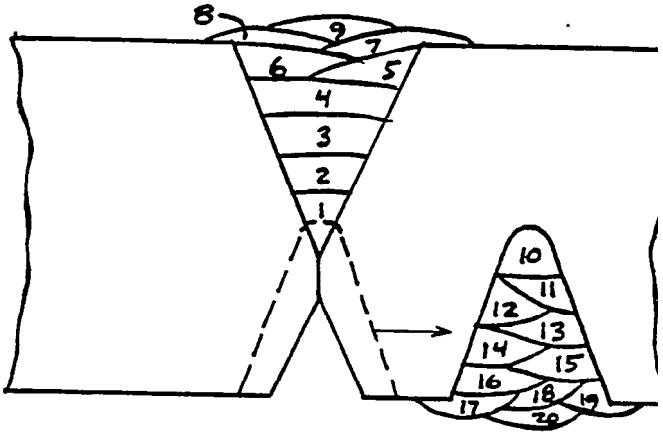
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL

Comments ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-3	500	30	A	1 1/4"	20 ipm	70 ipm	—	—	NO POWDER IN ROOT
4-8	550	34	A/B	1 1/4"	21 ipm	N/R	7.5	—	1.25:1 POWDER-TO-WIRE
9	↓	↓	A	↓	↓	↓	—	—	
10-18	↓	↓	A/B	↓	↓	↓	7.5	—	
19	↓	↓	A	↓	↓	↓	—	—	
20	550	34	A/B	1 1/4"	21 ipm	N/R	7.5	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	5-1-85	M729-28

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON MZ
PO/Heat/Lot: P545-34B4R/095119 METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2"x3"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial JAM

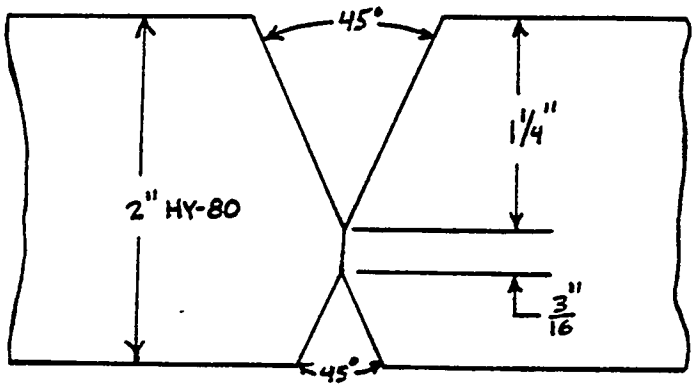
VISUAL INSPECT: ___ Ground X As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH; Flux OP121TT; PO/Heat/Lot N/R

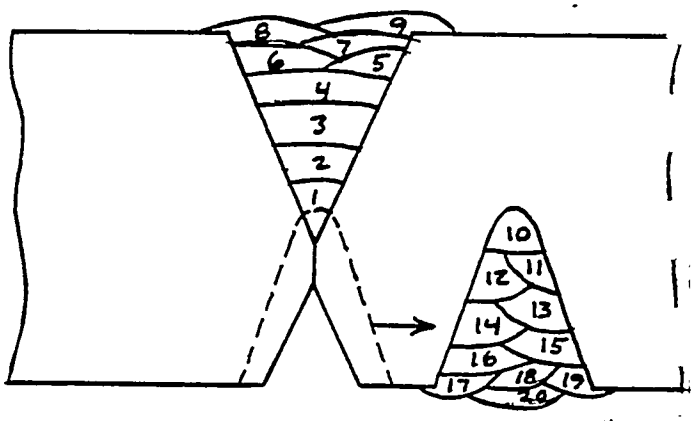
FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial LHB

RT: X Accept ___ Reject
Comments ___
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep	NOTES
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4-16	550	34	A/B	↓	21 ipm	↓	7.5	—	1.25:1 POWDER-TO-WIRE
17-20	↓	↓	A	↓	↓	↓	—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	5-3-85	M729-29

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi-~~ auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method
interpass (max) N/A
measured by
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN ___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON M2
PO/Heat/Lot: P545-3848B/095119 METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 12"x18"x 3/4"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BEAD-ON PLATE Avg Bead/Lgth 12"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ MT ___ Satisfactory ___ Gouged ___ PT ___ Unsatisfactory Procedure ___ Initial ___

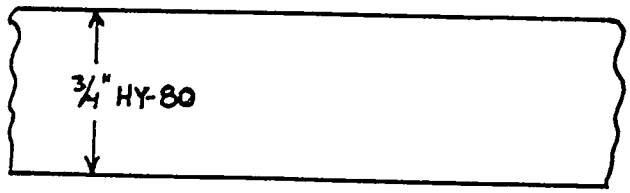
VISUAL INSPECT: ___ Ground X Satisfactory X As welded ___ Unsatisfactory Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH Flux OP 121 TT PO/Heat/Lot N/R

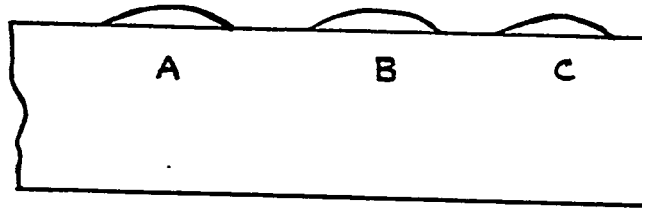
FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

RT: ___ Accept ___ Reject Comments ___ Radiograph to: ___ Interpret to: ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
A	550	34	A/B	1 1/4"	21 ipm	N/R	7.5	—	NO SURFACE ROUGHNESS
B	↓	↓	↓	↓	↓	↓	↓	—	"
C	↓	↓	↓	↓	↓	↓	↓	—	"
									1.25:1 POWDER-TO-WIRE

Technician/SSN: B.A. STINSON
Charge: 1026M-15
Date: 5-7-85
Joint No.: M729-30

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi~~ auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BAR
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? X Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 | Ⓑ OERLIKON MZ
PO/Heat/Lot: P545-35851/095171 | METAL POWDER
Specification: MIL-E-23765 | LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x 2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial TES

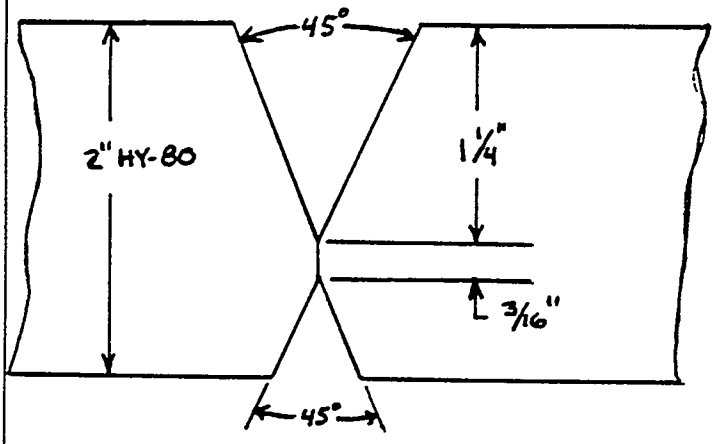
VISUAL INSPECT: X Ground ___ As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH; Flux OP121TT; PO/Heat/Lot N/R

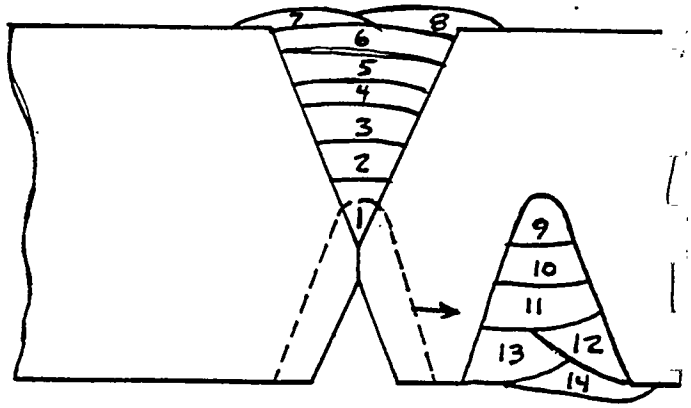
FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial PB

RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 C1
Comments: ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-3	500	30	A	1¼"	20 ipm	75 ipm	—	—	NO POWDER IN ROOT
4-7	700	38	A/B		15 ipm	N/R	4.2	—	.5:1 POWDER-TO-WIRE
8-9	↓	↓	A	↓	↓	↓	—	—	APPROX. 27 #/hr
10-13	↓	↓	A/B	↓	↓	↓	4.2	—	
14	↓	↓	A	↓	↓	↓	—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	5-3-85	M729-31

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON MZ
PO/Heat/Lot: P545-3585I/095171 METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2"x3"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial KRF

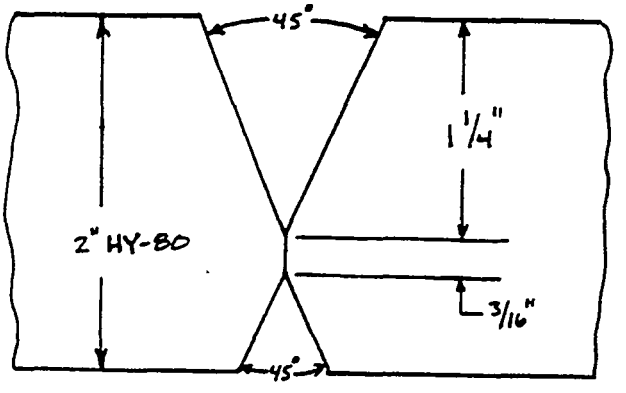
VISUAL INSPECT: X Ground ___ As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH; Flux OP121TT; PO/Heat/Lot N/R

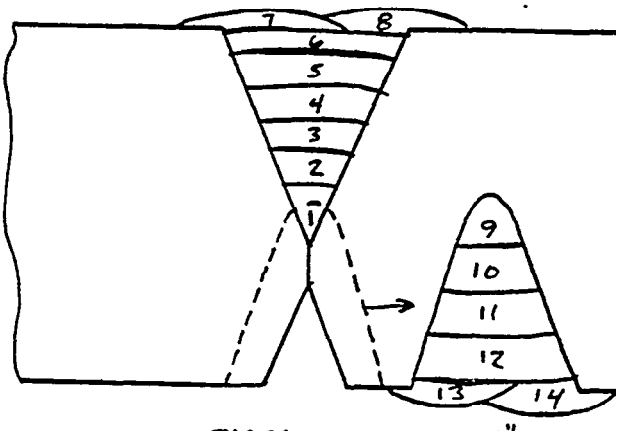
FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial PB

RT: X Accept ___ Reject
Comments ___
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1"

PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powder Mtr	Powder Dep.	NOTES
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4-7	700	38	A/B	1 1/4"	15 ipm	N/R	6.3	—	.75 : 1 POWDER-TO-WIRE
8-9	↓	↓	A	↓	↓	↓	—	—	APPROX. 31 #/hr
10-13			A/B				6.3	—	
14			A				—	—	

Technician/SSN: B.A. STINSON
Charge: 1026M-15
Date: 5-13-85
Joint No.: M729-32

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT: Power Supply/Model: LINCOLN IDEAL ARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L: Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 Ⓑ DERLIKON MZ
PO/Heat/Lot: P545-3600R/147D METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L: Type Dimensions: HY-80 34"x64"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 64"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X MT X Satisfactory
X Gouged ___ PT ___ Unsatisfactory
Procedure N23/123 Initial DDM

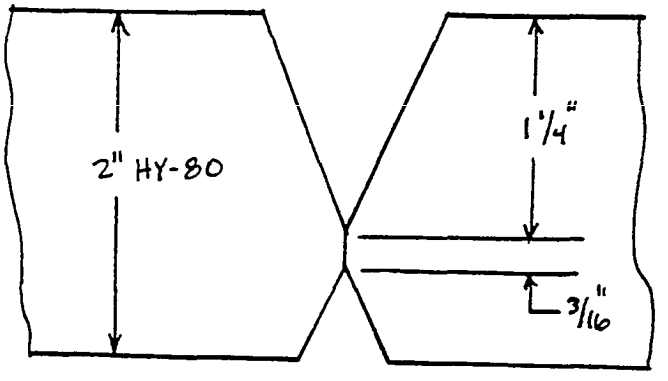
VISUAL INSPECT: X Ground X Satisfactory
___ As welded ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 880M
PO/Heat/Lot N/R

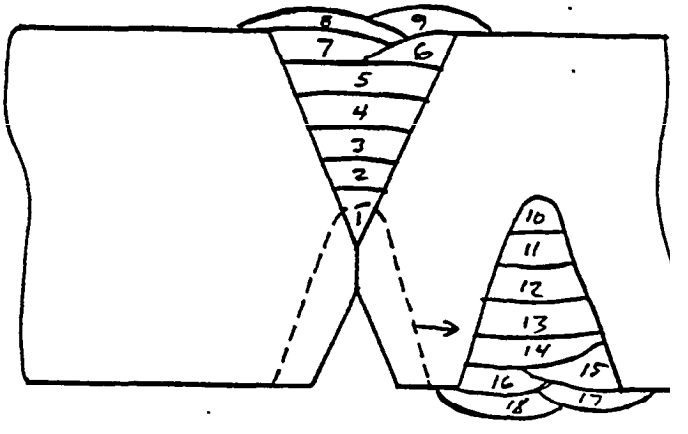
FINAL NDT: X MT X Satisfactory
___ PT ___ Unsatisfactory
Procedure N23/123 Initial JAM

RT: X Accept ___ Reject
Comments ___
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
									EXPLOSION TEST ASS'Y
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4-5		34	A/B		12 ipm		7.2	—	1.25:1 POWDER-TO-WIRE
6-11			A				—	—	
12-13			A/B				7.2	—	
14-18			A				—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	6-5-85	M729-41

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuild

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BATT
interpass (max) 300° F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 | Ⓑ OERLIKON M2
PO/Heat/Lot: P545-35851/095171 | METAL POWDER
Specification: MIL-E-23765 | LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N123 Initial DDM

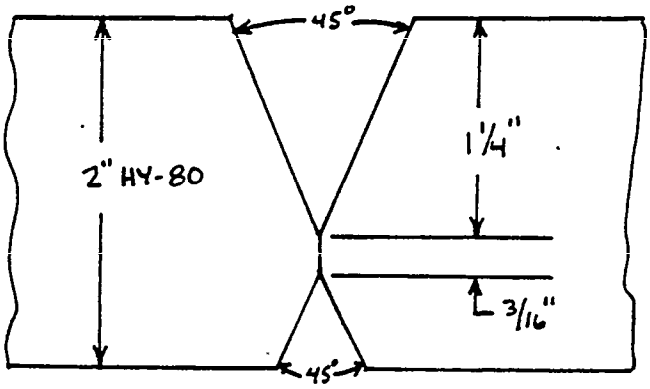
VISUAL INSPECT: X Ground ___ As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ Flux OP121TT PO/Heat/Lot N/R

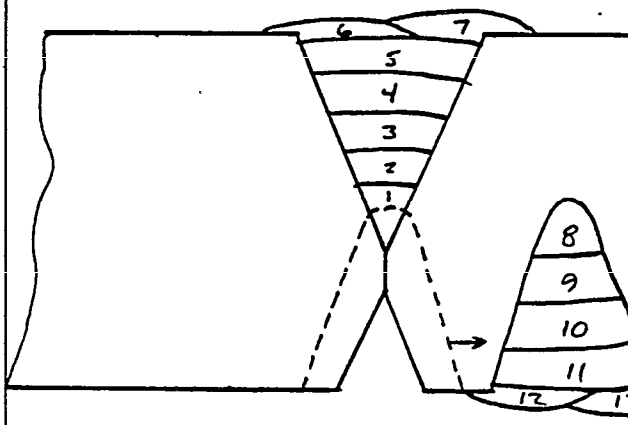
FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial JAM

RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-900

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powder Mfr	Powder Dep.	NOTES
1-3	500	30	A	1¼"	20 ipm	N/R	—	—	NO POWDER IN ROOT.
4-6	700	38	A/B		15 ipm		8.5	21 #/hr	1:1 POWDER-TO-WIRE
7-9	↓	↓	A	↓	↓	↓	—	—	APPROX. 29 #/hr
10-12	↓	↓	A/B	↓	↓	↓	8.5	21 #/hr	
13	↓	↓	A	↓	↓	↓	—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	5-14-85	M729-33

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BAR
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN ___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 Ⓑ OERLIKON M2
PO/Heat/Lot: P545-35851 / 075171 METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial PB

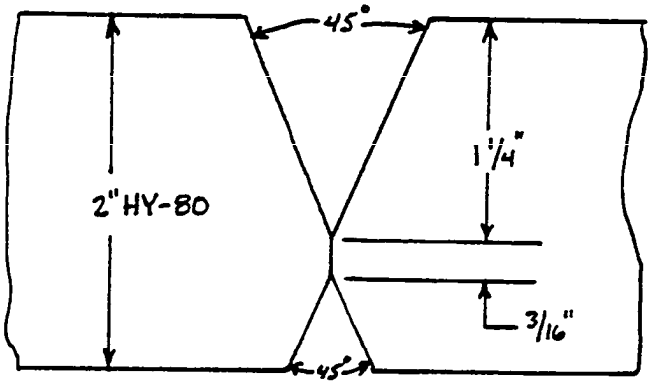
VISUAL INSPECT: X Ground ___ As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux OP 121 TT
PO/Heat/Lot N/R

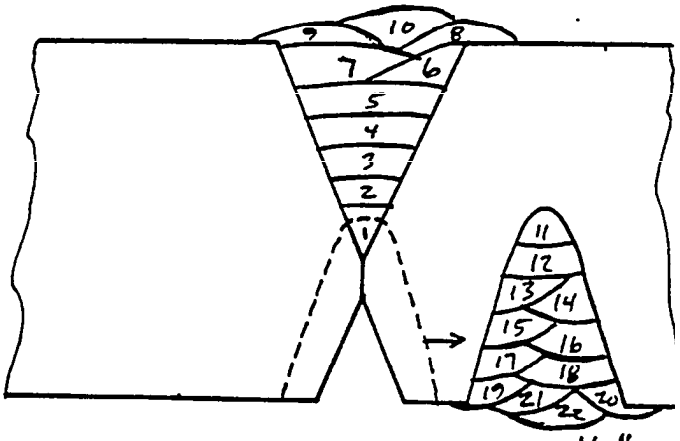
FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial JAM

RT: X Accept ___ Reject
Comments ___
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1 1/16"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4-6	700	38	A/B		15 ipm		4.2		.5:1 POWDER-TO-WIRE
7-10			A				—	—	APPROX. 26 #/hr
12-17			A/B				4.2	—	
18-22			A				—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-9	5-20-85	M729-36

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuild
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi~~ auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BAIZ
interpass (max) 300°F
measured by TEMPSTIC
maximum interpass reached? ✓ Yes ___

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 | Ⓑ OERLIKON MZ
PO/Heat/Lot: P545-35851/0951761 | METAL POWDER LOT 0784020
Specification: MIL-E-23765

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth ___

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial DDM

VISUAL INSPECT: ___ Ground X As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

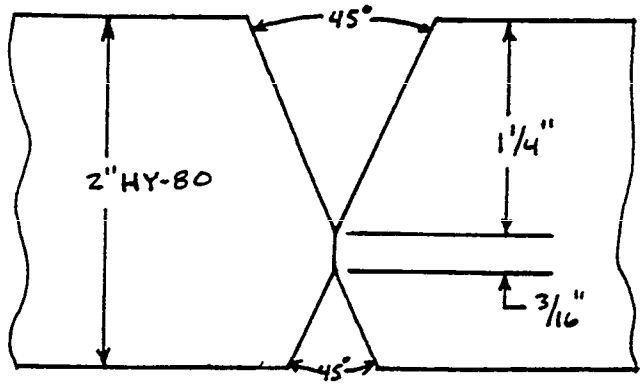
SHIELDING METHOD: Gas Mix ___ Flux OP 121 TT PO/Heat/Lot ___

FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial JAM

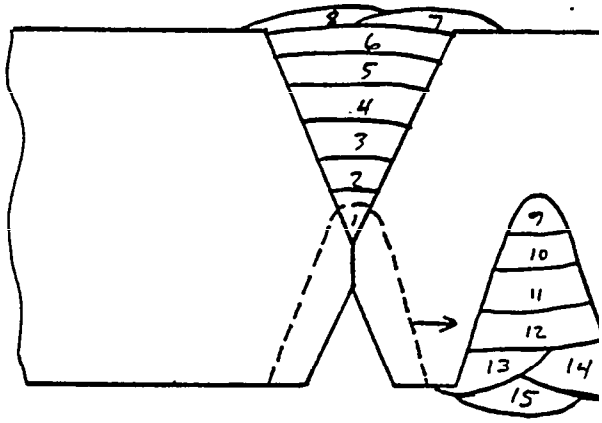
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000

Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr.	Pwdr Dep.	NOTES
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4-6		34	A/B		12 ipm		6.0		1:1 POWDER-TO-WIRE
7-9			A				—	—	APPROX. 23 #/hr
10-12			A/B				6.0	—	
13-15			A				—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	5-28-85	M729-37

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER Y semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BAR
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 | Ⓑ OERLIKON M2
PO/Heat/Lot: P545-3585R/0951761 | METAL POWDER
Specification: MIL-E-23765 | LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 34"x64"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BEV. 3 Avg Bead/Lgth 64"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X MT X Satisfactory; X Gouged ___ PT ___ Unsatisfactory
Procedure N23/123 Initial JAM

VISUAL INSPECT: ___ Ground X Satisfactory; X As welded ___ Unsatisfactory
Procedure ___ Initial HMR

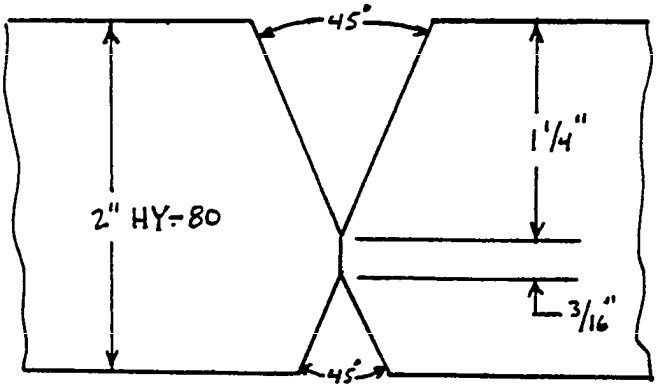
SHIELDING METHOD: Gas Mix ___ CFH; Flux LINCOLN 880M; PO/Heat/Lot N/R

FINAL NDT: X MT X Satisfactory; ___ PT ___ Unsatisfactory
Procedure N23/123 Initial JAM

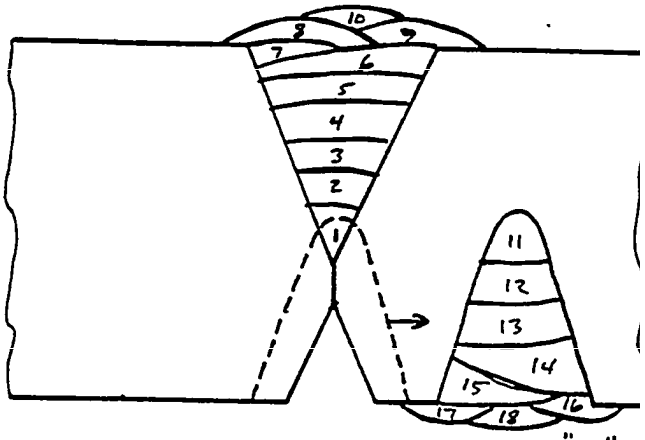
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL

Comments: ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 7/8-1"

PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	EXPLOSION TEST ASS'Y
4-6		34	A/B		12 ipm		7.2	—	NO POWDER IN ROOT
7-11			A				—	—	1.25:1 POWDER-TO-WIRE
12-13			A/B				7.2	—	
14-18	↓	↓	A	↓	↓	↓	—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	5-31-85	M729-38

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuild
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BAR
interpass (max) 300°F
measured by TEMPSTIC
maximum interpass reached? ✓ Yes ___

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 Ⓑ OERLIKON MZ
PO/Heat/Lot: P545-3600R/147D METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 34"x84"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 86"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X MT X Satisfactory / X Gouged ___ PT ___ Unsatisfactory
Procedure N23/123 Initial PB

VISUAL INSPECT: ___ Ground X Satisfactory / X As welded ___ Unsatisfactory
Procedure ___ Initial HMR

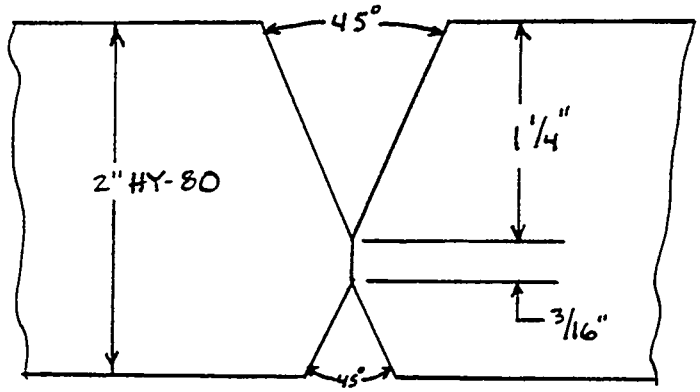
SHIELDING METHOD: Gas Mix ___ Flux LINCOLN 880M PO/Heat/Lot ___ N/R

FINAL NDT: X MT X Satisfactory / ___ PT ___ Unsatisfactory
Procedure N23/123 Initial JAM

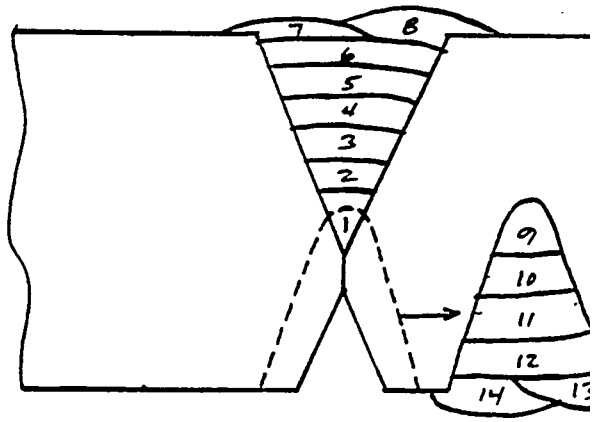
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-90

Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
									EXPLOSION TEST ASS
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4-5		34	A/B		12 ipm		7.2	—	1.25:1 POWDER-TO-W
6-9			A				—	—	
10-11			A/B				7.2	—	
12-14	↓	↓	A	↓	↓	↓	—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-85	6-4-85	M729-40

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method
interpass (max) N/A
measured by
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: (A) 1/8" LINCOLN MIL-100S-1
PO/Heat/Lot: P545-3600-R/147D
Specification: MIL-E-23765
(B)

TUNGSTEN: Type / Size / Other

BASE MAT'L:
Type Dimensions: HY-80 12"x18"x1"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BIV.2 Avg Bead/Lgth 18"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

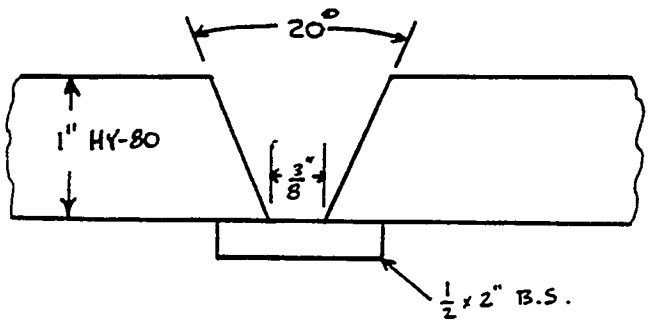
VISUAL INSPECT: ___ Ground ___ As welded ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

SHIELDING METHOD: Gas Mix ___ CFH; Flux LINCOLN 880M; PO/Heat/Lot N/R

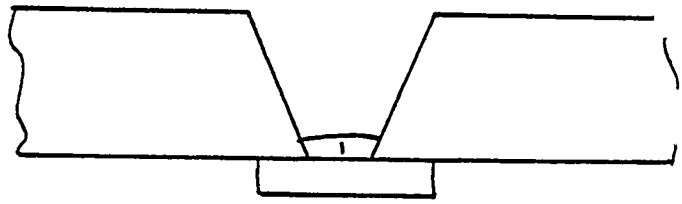
FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

RT: ___ Accept ___ Reject Radiograph for ___ Interpret to: ___ Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED		NOTES
42	500	34	A	1 1/4"	20 ipm	N/R		ROLLED BEAD
43	500	36	A	1 1/4"	21 ipm	N/R		ROLLED BEAD
44	425	34	A	1 1/4"	17 ipm	N/R		ROLLED BEAD
46	475	34	A	1 1/4"	15 ipm	N/R		GOOD APPEARANCE

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	6-18-85	M729 - 42, 43, 44, 46

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi~~ auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 | Ⓑ OERLIKON M2
PO/Heat/Lot: P545-3600R/147D | METAL POWDER
Specification: MIL-E-23765 | LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2"x3"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial TES

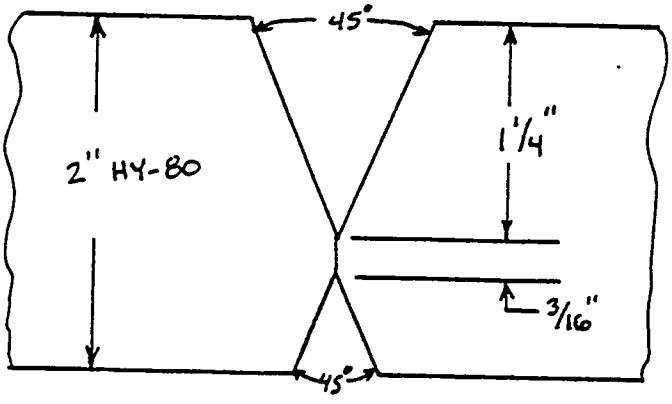
VISUAL INSPECT: ___ Ground X As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 880M
PO/Heat/Lot N/R

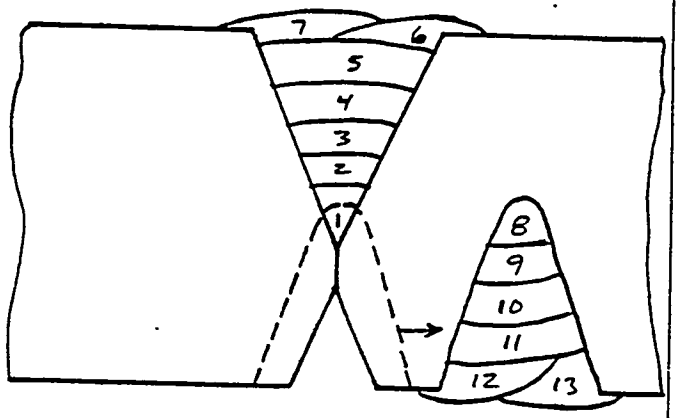
FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial ___

RT: ___ Accept ___ Reject
Comments ___
Radiograph to: ___ Interpret to: ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 7/8"-1"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4-5		34	A/B		12 ipm		7.2	—	1.25:1 POWDER-TO-WIRE
6-8			A				—	—	
9-13	↓	↓	A/B	↓	↓	↓	7.2	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	6-28-85	M729-45

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 | Ⓑ OERLIKON MZ
PO/Heat/Lot: PS45-3600R/147D | METAL POWDER
Specification: MIL-E-23765 | LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x1" T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BIV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

VISUAL INSPECT: ___ Ground X As welded X Satisfactory ___ Unsatisfactory Procedure ___ Initial HMR

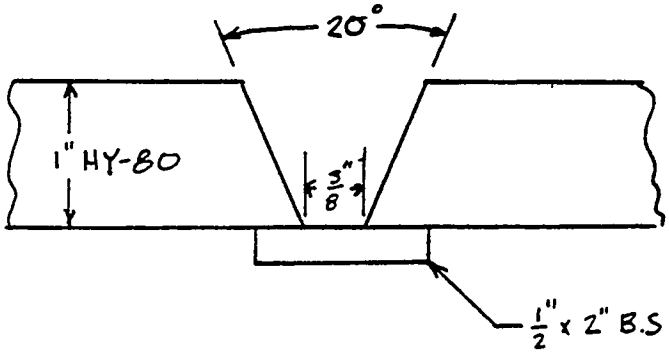
SHIELDING METHOD: Gas Mix ___ CFH; Flux LINCOLN 880M; PO/Heat/Lot N/R

FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory Procedure N23/123 Initial W.S.L

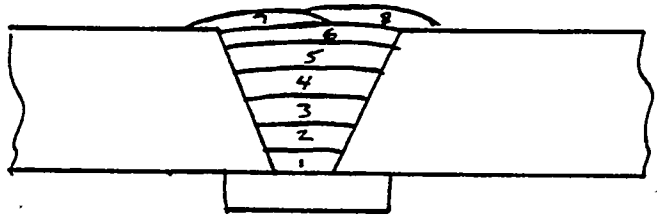
RT: X Accept ___ Reject Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 Cl 1

Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep	NOTES
1	475	34	A	1 1/4	15 ipm	N/R	—	—	FLUX DIFFICULT TO REMOVE
2	550	34	A		21 ipm		—	—	
3-6	550		A/B				7.5	—	1.25:1 POWDER-TO-WIRE
7-8			A				—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	7-2-85	M729-47

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 | Ⓑ OERLIKON MZ
PO/Heat/Lot: PS45-3600R/147D | METAL POWDER
Specification: MIL-E-23765 | LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2'x3'x1" T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BIV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

VISUAL INSPECT: ___ Ground X As welded X Satisfactory ___ Unsatisfactory Procedure ___ Initial HMR

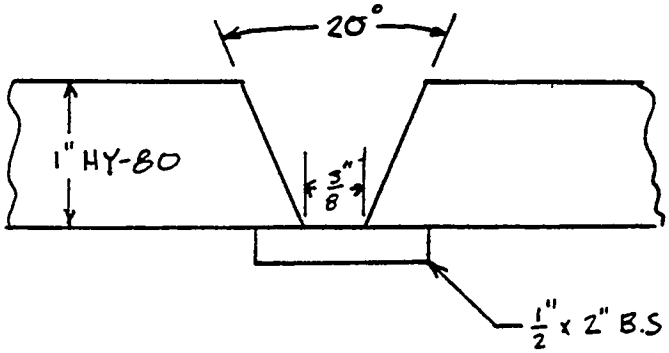
SHIELDING METHOD: Gas Mix ___ CFH; Flux LINCOLN 880M; PO/Heat/Lot N/R

FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory Procedure N23/123 Initial W.S.L

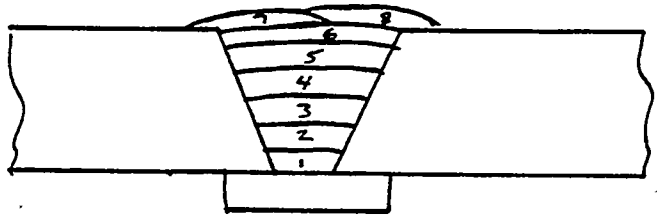
RT: X Accept ___ Reject Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 Cl 1

Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep	NOTES
1	475	34	A	1 1/4	15 ipm	N/R	—	—	FLUX DIFFICULT TO REMOVE
2	550	34	A		21 ipm		—	—	
3-6	550		A/B				7.5	—	1.25:1 POWDER-TO-WIRE
7-8			A				—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	7-2-85	M729-47

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi~~ auto

POSITION: X 1 ___ 3 ___ 5 ___ G X plate ___ 2 ___ 4 ___ 6 X F ___ pipe

Preheat (min) N/A
method ___
interpass (max) N/A
measured by ___
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: (A) 1/8" LINCOLN MIL-100S-1 | (B) OERLIKON MZ
PO/Heat/Lot: P545-3600R/147D | METAL POWDER
Specification: ___ | LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: C/S, 6"x18"x3/4"T
PO/Heat/Lot: N/R
Specification: MIL-S-22698

JOINT: Type PTZS-1 Avg Bead/Lgth 18"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

VISUAL INSPECT: ___ Ground X As welded X Satisfactory ___ Unsatisfactory Procedure ___ Initial HMR

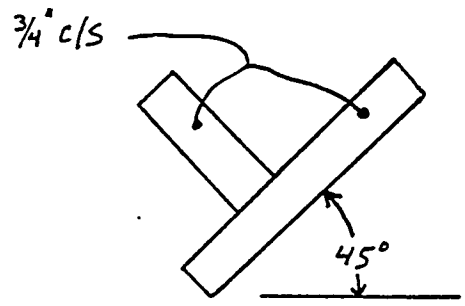
SHIELDING METHOD: Gas Mix ___ CFH Flux LINCOLN 880M PO/Heat/Lot N/R

FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

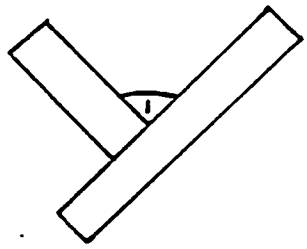
RT: ___ Accept ___ Reject Radiograph to: ___ Interpret to: ___

Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Push Mtr		NOTES
48	550	34	A/B	1 1/4"	21 ipm		7.5		
49	600	34	A/B	1 1/4"	24 ipm		7.5		

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	7-5-85	M729-48, 49

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuild
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 ___ G X plate ___ 2 ___ 4 ___ 6 X F ___ pipe

Preheat (min) N/A
method
interpass (max) N/A
measured by
maximum interpass reached? ___ Yes ___

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 Ⓑ OERLIKON MZ
PO/Heat/Lot: P545-3600R/1470 METAL POWDER LOT 0784020
Specification:

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: C/S 18"x6"x 3/4"T
PO/Heat/Lot: N/R
Specification: MIL-S-22698

JOINT: Type PTS.1 Avg Bead/Lgth 18"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ MT ___ Satisfactory ___ Gouged ___ PT ___ Unsatisfactory Procedure ___ Initial ___

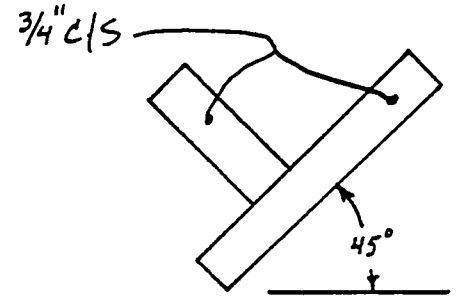
VISUAL INSPECT: ___ Ground X Satisfactory X As welded ___ Unsatisfactory Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ Flux LINCOLN 880M PO/Heat/Lot N/R

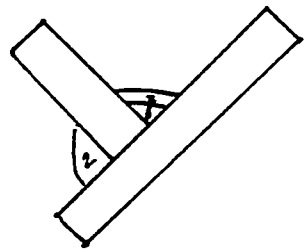
FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

RT: ___ Accept ___ Reject Radiograph to: ___ Comments ___ Interpret to: ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powder Mtr		NOTES
51 1-2	550	34	A/B	1 1/4"	21 ipm		7.5		GOOD APPEARANCE, 55K
52 1-2	500	34	A/B	1 1/4"	12 ipm		7.2		GOOD APPEARANCE, 85K

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	7-8-85	M729-51,

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 Ⓑ OERLIKON MZ
PO/Heat/Lot: P545-3600R/1470 METAL POWDER
Specification: MIL-E-23765 LOT 0880124

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 24"x18"x1"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BIV.3 Avg Bead/Lgth 18"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory Procedure ___ Initial ___

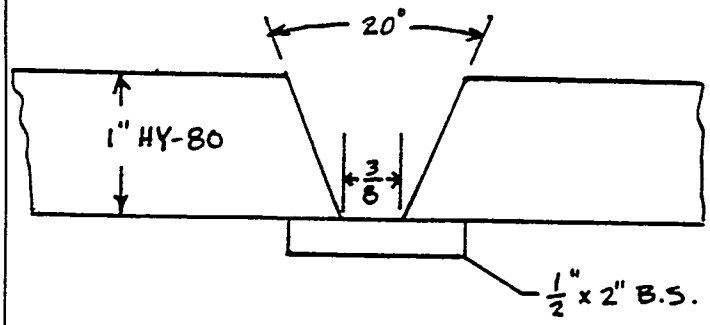
VISUAL INSPECT: ___ Ground X As welded X Satisfactory ___ Unsatisfactory Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH Flux LINCOLN 880M PO/Heat/Lot ___ N/R

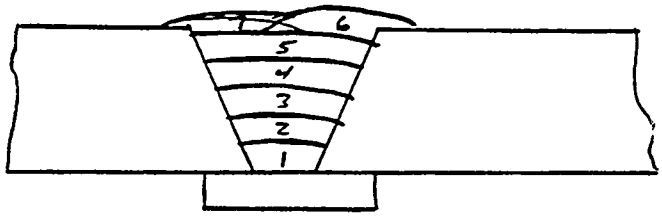
FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory Procedure N23/123 Initial WJL

RT': X Accept ___ Reject Comments ___ Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr		NOTES
1	475	34	A	1 1/4"	15 ipm	N/R	—		NO POWDER IN ROOT
2	500	30	A		12 ipm		—		
3-5			A/B				4.2		.75:1 POWDER-TO-WIRE
6-7			A				—		

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	7-12-85	M729-54

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuil
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATEIZ BAR
interpass (max) 300°F
measured by TEMPSTI
maximum interpass reached? ✓ Yes ___

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 Ⓑ OERLIKON MZ
PO/Heat/Lot: P545-3600R/1470 METAL POWDER
Specification: MIL-E-23765 LOT 0880124

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 24"x18"x1"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BIV.3 Avg Bead/Lgth 18"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT Procedure ___ Satisfactory ___ Unsatisfactory Initial ___

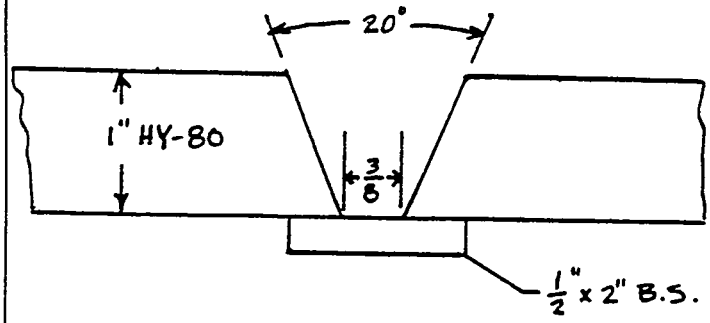
VISUAL INSPECT: ___ Ground X As welded Procedure ___ X Satisfactory ___ Unsatisfactory Initial HMR

SHIELDING METHOD: Gas Mix ___ Flux LINCOLN 880M PO/Heat/Lot N/R

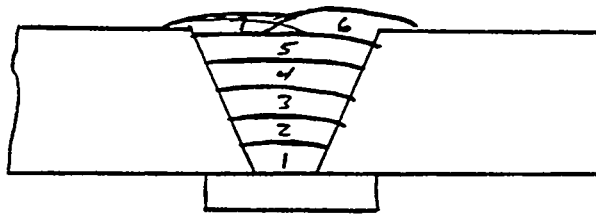
FINAL NDT: X MT ___ PT Procedure N23/123 X Satisfactory ___ Unsatisfactory Initial WJL

RT': X Accept ___ Reject Radiograph to: MIL-STD-271 Comments ___ Interpret to: 0900-003-900

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powder Mtr		NOTES
1	475	34	A	1 1/4"	15 ipm	N/R	—		NO POWDER IN ROOT
2	500	30	A		12 ipm		—		
3-5			A/B				4.2		.75:1 POWDER-TO-W
6-7			A				—		

Technician/SSN: B.A. STINSON
Charge: 1026M-15
Date: 7-12-85
Joint No.: M729-5

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN ___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 Ⓑ OERLIKON MZ
PO/Heat/Lot: P545-3600B/147D METAL POWDER
Specification: MIL-E-23765 LOT 0881024

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80, 24"x18"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 18"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged; X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial WJL

VISUAL INSPECT: X Ground ___ As welded; X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

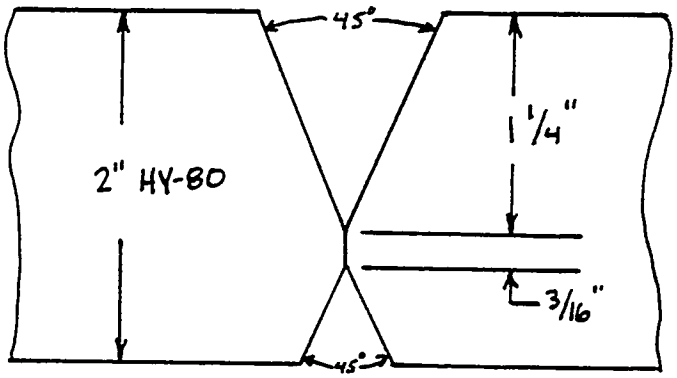
SHIELDING METHOD: Gas Mix ___ CFH; Flux LINCOLN 880M; PO/Heat/Lot N/R

FINAL NDT: X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial DDM

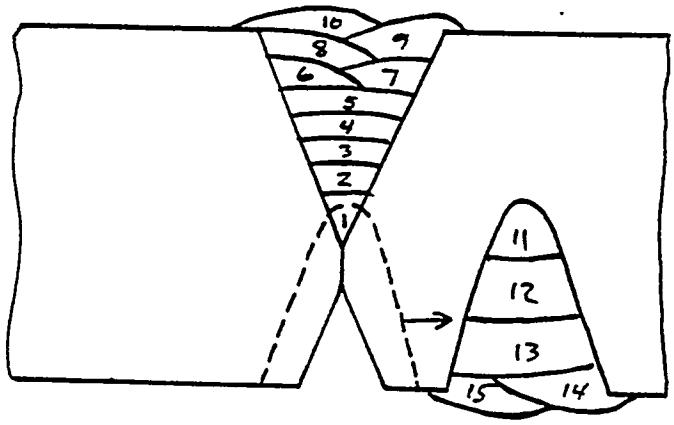
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 C1 1

Comments: ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT.
4-5	700	38	A/B		15 ipm		4.2	—	.5:1 POWDER-TO-WIRE
6-11			A				—	—	
12-13			A/B				4.2	—	
14-15			A				—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	7/18/85	M729-55

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
Interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 Ⓑ OERLIKON M2
PO/Heat/Lot: P545-3600R/147D METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 24"x18"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV-3 Avg Bead/Lgth 18"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X MT X Satisfactory; X Gouged ___ PT ___ Unsatisfactory
Procedure N23/123 Initial ___

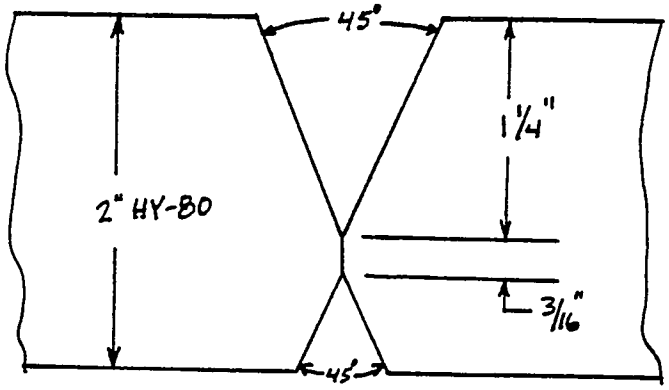
VISUAL INSPECT: ___ Ground X Satisfactory; X As welded ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 880M
PO/Heat/Lot ___ N/R

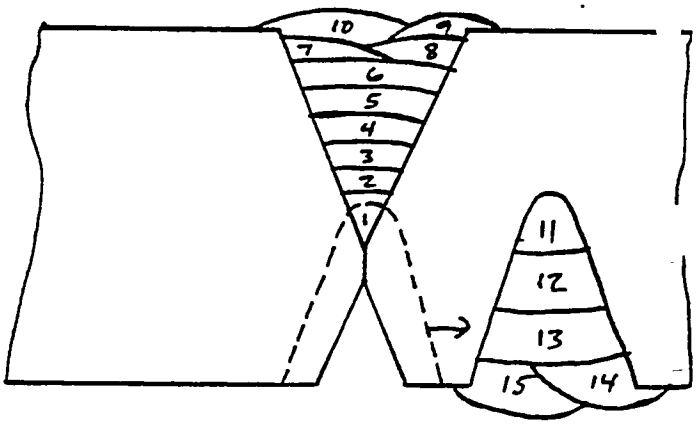
FINAL NDT: X MT X Satisfactory; ___ PT ___ Unsatisfactory
Procedure N23/123 Initial ___

RT: ___ Accept X Reject
Comments: SLAG
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 Cl 1

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powder Mix	Powder Dep	NOTES
									VARIOUS PARAMETERS
1-3	500	30	A	1¼"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4		34	A/B		12 ipm		7.2	—	1.25:1 POWDER-TO-WIRE
5		37			13 ipm		7.2	—	
6		39			14 ipm		7.2	—	
7-10			A				—	—	
11		31			11 ipm		—	—	
12-13			A/B				7.2	—	
14-15			A				—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	7/25/85	M729-56

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN HA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 Ⓑ OERLIKON M2
PO/Heat/Lot: 545-3600B / 147D METAL POWDER
Specification: MIL-E-23765 LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2"x3"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type B2V.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial PB

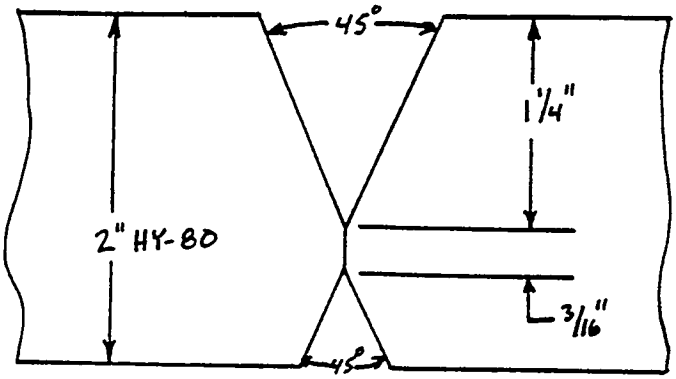
VISUAL INSPECT: ___ Ground X As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 880M
PO/Heat/Lot ___ N/R

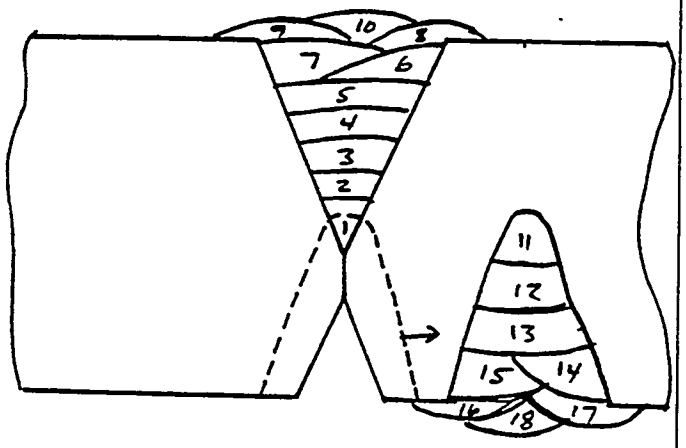
FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial WJL

RT': ___ Accept X Reject
Comments: TRAPPED SLAG, APPROX 6" LONG NEAR END OF BUTT
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL1

JOINT SKETCH



BEAD PLACEMENT



PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mfr	Pwdr Dep.	NOTES
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4-6		34	A/B		12 ipm		7.2	—	1.25:1 POWDER-TO-WIRE
7-11			A				—	—	
12-13			A/B				7.2	—	
14-18			A				—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	8-5-85	M729-57

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X ~~semi~~ auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINDE MIL-100S-1 | Ⓑ OERLIKON MZ
PO/Heat/Lot: 545-3425R/095099 | METAL POWDER
Specification: MIL-E-23765 | LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 2"x3"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BZV.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial JAM

VISUAL INSPECT: ___ Ground X As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

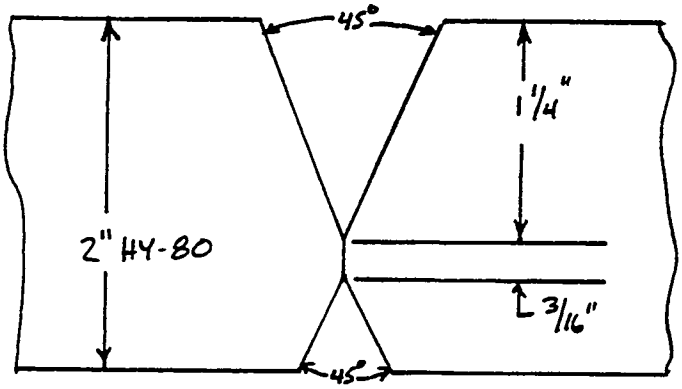
SHIELDING METHOD: Gas Mix ___ CFH
Flux OERLIKON OP121TT
PO/Heat/Lot N/R

FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial JAM

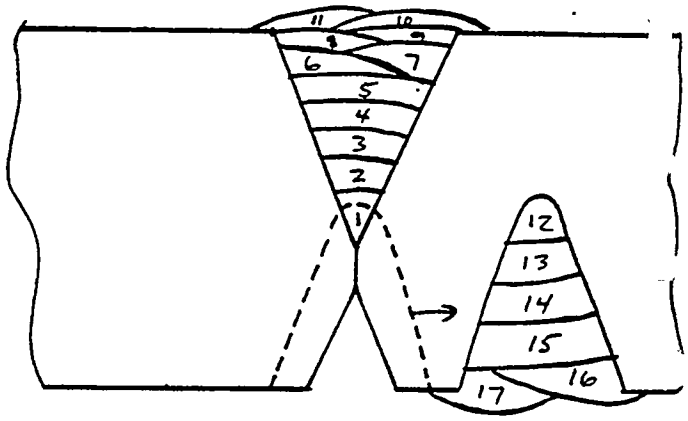
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL

Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powdr Mtr	Powdr Dep.	NOTES
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4-6		34	A/B		12 ipm		7.2	—	1.25:1 POWDER-TO-WIRE
7-12			A				—	—	
13-14			A/B				7.2	—	
15-17			A				—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	8-15-85	M729-59

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT

Power Supply/Model	LINCOLN IDEALARC 1500	
Torch/gas cup/wire feeder	LINCOLN NA-35	
Current	___ AC X DCEP ___ DCEN	___ AC ___ DCEP ___ DCEN

FILLER MAT'L

	Ⓐ	Ⓑ
Size/Brand/Type	Ⓐ 1/8" LINCOLN MIL-100S-1	Ⓑ OERLIKON MZ
PO/Heat/Lot	545-3600R / 147D	METAL POWDER
Specification	MIL-E-23765	LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L

Type Dimensions	HY-80 2'x3'x2"T
PO/Heat/Lot	N/R
Specification	MIL-S-16216

JOINT: Type BZU.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/GOUGING: ___ Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial KRF

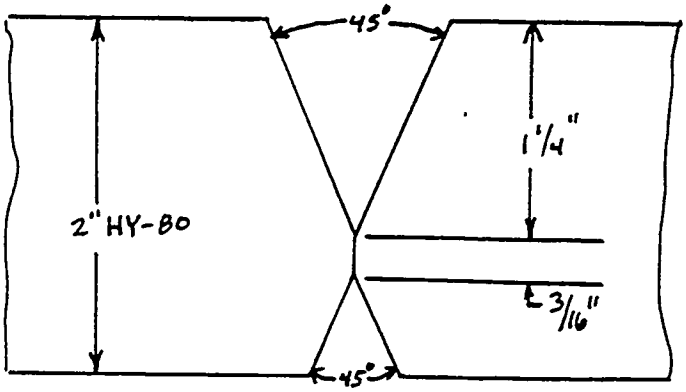
VISUAL INSPECT: ___ Ground X As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux OERLIKON OPI21TT
PO/Heat/Lot ___ N/R ___

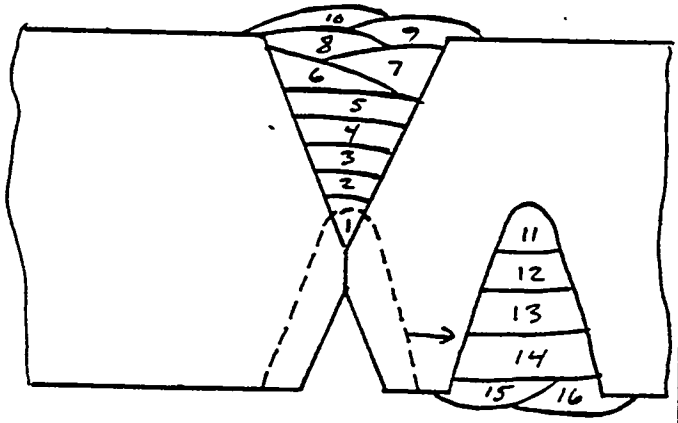
FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial WJL

RT: ___ Accept X Reject
Comments Approx 6" Trapped Slag, Cut off for mechanical testing.
Radiograph to: MIL-STD-271 Interpret to: D900-003-9000 CL1

JOINT SKETCH



BEAD PLACEMENT



PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-3	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
4-5	550	34	A/B	1 1/4"	12 ipm		7.2	—	1.25:1 POWDER-TO-WIRE
6-11	↓	↓	A	↓	↓	↓	—	—	
12-13	↓	↓	A/B	↓	↓	↓	7.2	—	
14-16	↓	↓	A	↓	↓	↓	—	—	

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	9-24-85	M729-60

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method N/A
interpass (max) N/A
measured by N/A
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: (A) 5/32" LINDE MIL-A1 (B) OERLIKON M13K
PO/Heat/Lot: P545-3574-R / 08115 METAL POWDER
Specification: MIL-E-18193 LOT 0784021-1

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: C/S 24"x36"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-22698

JOINT: Type B2V.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: X Ground X Gouged X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23 Initial DDM

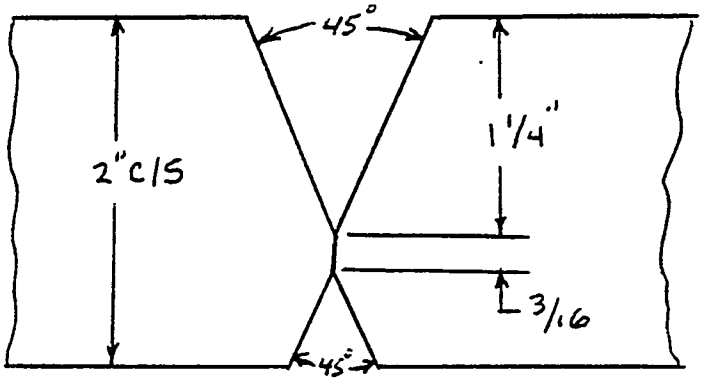
VISUAL INSPECT: X Ground ___ As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 780 / MIL-F2
PO/Heat/Lot P54-3-3552-R 1305

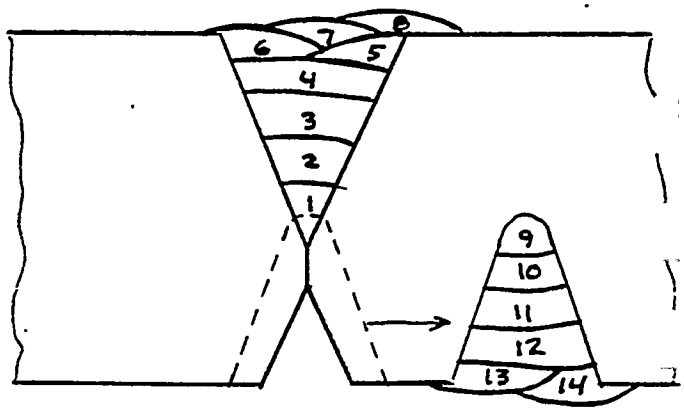
FINAL NDT: ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory
Procedure ___ Initial ___

RT: ___ Accept ___ Reject
Comments ___
Radiograph to: ___ Interpret to: ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 7/8"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-2	550	30	A	1 1/4"	18 ipm	45 ipm	—	—	NO POWDER IN ROOT
3-8	550	34	A/B	1 1/4"	18 ipm	47 ipm	6.8	—	1.25 : 1 POWDER-TO-WIRE
9-10	550	34	A	1 1/4"	18 ipm	47 ipm	—	—	
11-14	550	34	A/B	1 1/4"	18 ipm	47 ipm	6.8	—	MACRO SHOWED TRAPPED SLAG ON 1ST SIDE

Technician/SSN	Charge	Date	Joint No.
K. R. FISHER	1026M-15	10-21-85	M729-61

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method N/A
interpass (max) N/A
measured by N/A
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN ___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: (A) 5/32" LINDE MIL-A1 (B) OERLIKON M-13K
PO/Heat/Lot: PS45-3574-R / 08115 METAL POWDER
Specification: MIL-E-18193 LOT 0784021-1

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: C/S 24"x36"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-22698

JOINT: Type B2V.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDI: ___ Ground X Gouged; X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23 Initial LHB

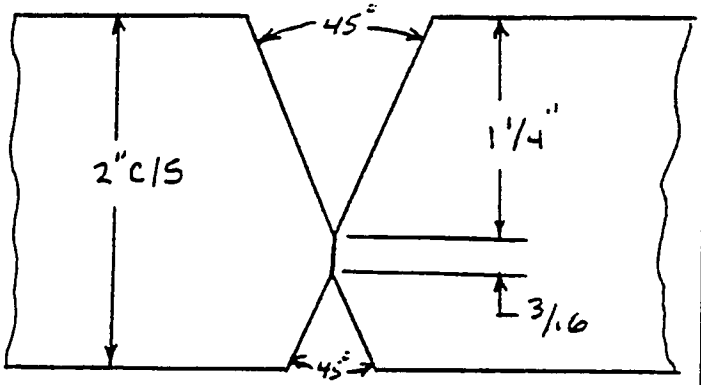
VISUAL INSPECT: ___ Ground X As welded; X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 780 / MIL-F2
PO/Heat/Lot PS4-3-3552-R 1335

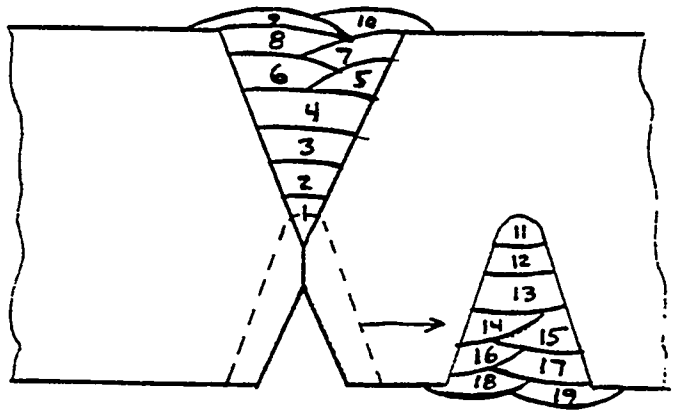
FINAL NDT: X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23 Initial JAM

RT - ___ Accept ___ Reject
Radiograph to: ___ Interpret to: ___
Comments: ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 3/4"

PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powder Mtr	Powder Dep.	NOTES
1-2	500	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
3	550	34	A	1 1/4"	18 ipm		—	—	1.25:1 POWDER-TO-WIRE
4-8	550	34	A/B	1 1/4"	18 ipm		6.8	—	
9-10	550	34	A	1 1/4"	18 ipm		—	—	PARAMETERS SEEM LOW
11-12	500	30	A	1 1/4"	20 ipm		—	—	
13-17	550	34	A/B	1 1/4"	18 ipm		6.8	—	MACRO SHOWED TRAPPED
18-19	550	34	A	1 1/4"	18 ipm		—	—	SLAG ON EACH END OF
									THE JOINT

Technician/SSN	Charge	Date	Joint No.
K. R. FISHER	1026M-15	10-24-85	M729-62

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method N/A
interpass (max) N/A
measured by N/A
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: (A) 5/32" LINDE MIL-A1 (B) OERLIKON M-13K
PO/Heat/Lot: P545-3574-R / 08115 METAL POWDER
Specification: MIL-E-18193 LOT 0784021-1

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: C/S 24"x36"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-22698

JOINT: Type B2V.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt: 0°

BACKSIDE PREP/NDT: ___ Ground X Gouged; X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23 Initial BAS

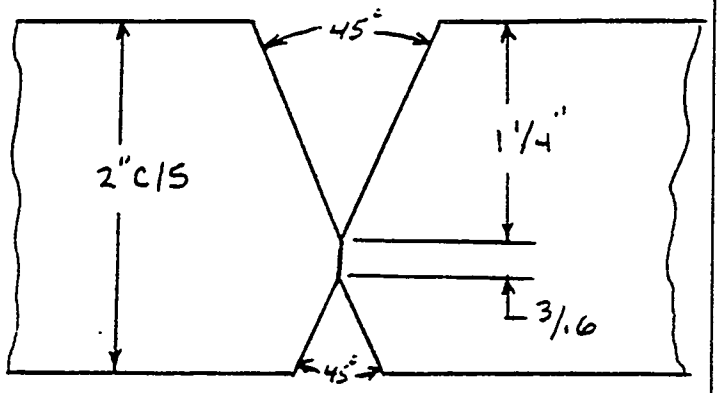
VISUAL INSPECT: ___ Ground X As welded; X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 780 / MIL-F2
PO/Heat/Lot P54-3-3552-R 1355

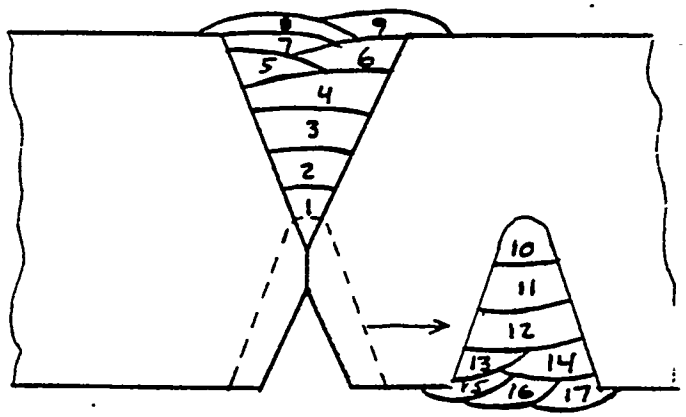
FINAL NUT: ___ MT ___ PT; ___ Satisfactory ___ Unsatisfactory
Procedure ___ Initial ___

RT.: ___ Accept ___ Reject
Radiograph to ___ Interpret to: ___
Comments ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 3/4"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-2	550	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
3	550	34	A	1 1/4"	18 ipm		—	—	1.25:1 POWDER-TO-WIRE
4-6	550	34	A/B	1 1/4"	18 ipm		6.8	—	
7-9	550	34	A	1 1/4"	18 ipm		—	—	
10-11	550	30	A	1 1/4"	20 ipm		—	—	
12-15	550	34	A/B	1 1/4"	18 ipm		6.8	—	MACRO SHOWED TRAPPED
16-17	550	34	A	1 1/4"	18 ipm		—	—	SLAG AT BOTH ENDS OF THE JOINT.

Technician/SSN	Charge	Date	Joint No.
K.R. FISHER	1026M-15	10-30-85	M729-63

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method N/A
Interpass (max) N/A
measured by N/A
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN

___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: (A) 5/32" LINDE MIL-A1 (B) OERLICON M-13K
PO/Heat/Lot: P545-357A-R / 08115 METAL POWDER
Specification: MIL-E-18193 LOT 0784021-1

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: C/S 24"x36"x2"T
PO/Heat/Lot: N/R
Specification: MIL-S-22698

JOINT: Type B2V.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23 Initial LHB

VISUAL INSPECT: X Ground ___ As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

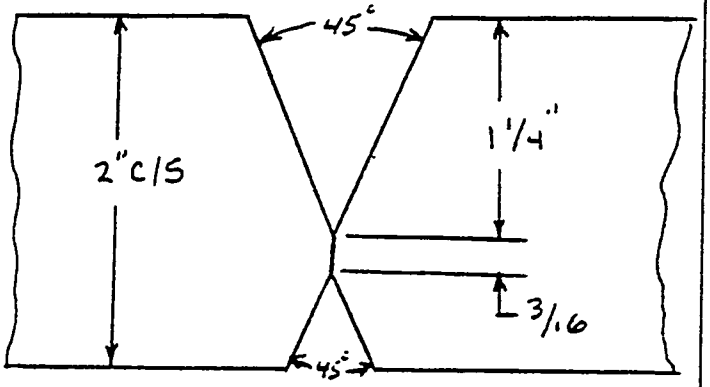
SHIELDING MEDIUM: Gas Mix ___ CFH
Flux LINCOLN 780 / MIL-F2
PO/Heat/Lot P54-3-3552-R 1385

FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23 Initial LHB

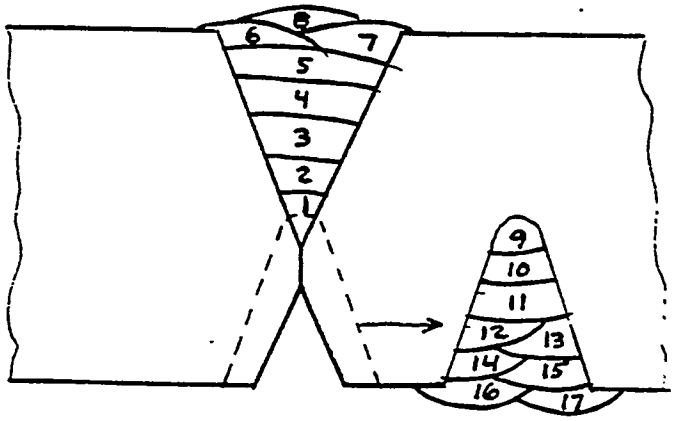
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 Cl.1

Comments ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1/8"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-2	550	30	A	1 1/4"	20 ipm	N/R	—	—	NO POWDER IN ROOT
3		34	A		18 ipm		—	—	
4-7			A/B				6.8	—	1.25:1 POWDER-TO-WIRE
8			A				—	—	
9-10		30	A		20 ipm		—	—	
11-14		34	A/B		18 ipm		6.8	—	
15-17			A				—	—	

Technician/SSN	Charge	Date	Joint No.
K.R. FISHER	1026M-15	11-5-85	M729-64

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method N/A
Interpass (max) N/A
measured by N/A
maximum interpass reached? ___ Yes ___ No

EQUIPMENT
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L
Size/Brand/Type: Ⓐ 5/32" LINDE MIL-A1 Ⓑ OERLIKON M-13K
PO/Heat/Lot: P545-3574-R / 08115 METAL POWDER
Specification: MIL-E-18193 LOT 0784021-1

TUNGSTEN
Type ___
Size ___
Other ___

BASE MAT'L
Type Dimensions: C/S 24"x36"x2"T
PO/Heat/Lot: H.O. 16753829
Specification: MIL-S-22698

JOINT
Type B2V.3
Avg Bead/Lgth 36"

TORCH ANGLE
Lead/Lag 0°
Tilt 0°

BACKSIDE PREP/NDI
___ Ground X MT X Satisfactory
X Gouged ___ PT ___ Unsatisfactory
Procedure N23 Initial BAS

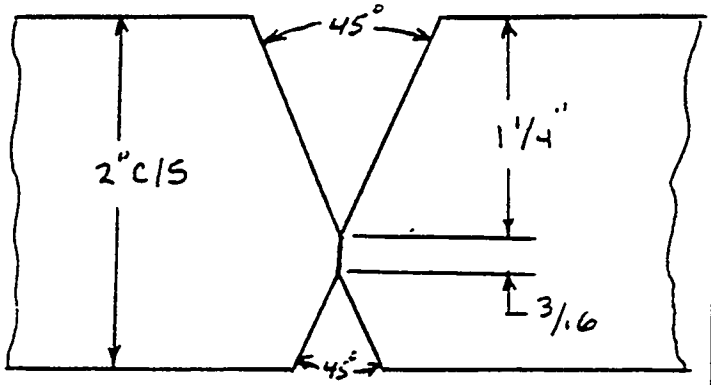
VISUAL INSPECT
X Ground X Satisfactory
___ As welded ___ Unsatisfactory
Procedure ___ Initial HMR

SHIELDING METHOD
Gas Mix ___ CFH
Flux LINCOLN 780 / MIL-F2
PO/Heat/Lot P54-3-3552-R 1362

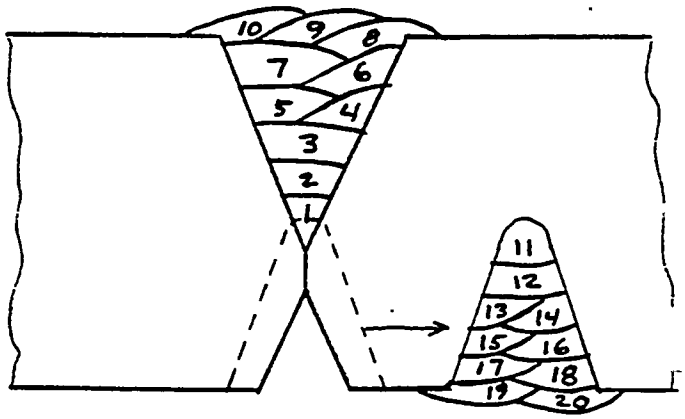
FINAL NDI
X MT X Satisfactory
___ PT ___ Unsatisfactory
Procedure N23 Initial LHB

RT:
___ Accept:
X Reject:
Comments: LACK OF PENETRATION, DUE TO BEAD PLACEMENT
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1 1/16"

PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powdr Mtr	Powdr Dep.	NOTES
1-2	550	30	A	1 1/4"	21 ipm	N/R	—	—	NO POWDER IN ROOT
3-7	600	36	A/B	1 1/4"	20 ipm		7.4	—	1.25:1 POWDER-TO-WIRE
8-10	↓	↓	A		↓		—	—	
11-12	550	30	A		21 ipm		—	—	
13-20	600	36	A/B	↓	20 ipm	↓	7.4	—	

Technician/SSN	Charge	Date	Joint No.
K.R. FISHER	1026M-15	11-19-85	M729-66

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method N/A
Interpass (max) N/A
measured by N/A
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 5/32" LINDE MIL-A1 | Ⓑ OERLIKON EL-12
PO/Heat/Lot: P545-3574-R / 08115 | METAL POWDER
Specification: MIL-E-18193 | LOT 1280038

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: C/S 24"x36"x2"T
PO/Heat/Lot: H.O. 16953829
Specification: MIL-S-22698

JOINT: Type B2V.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDI: ___ Ground X Gouged | X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23 Initial LHB

VISUAL INSPECT: X Ground ___ As welded | X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

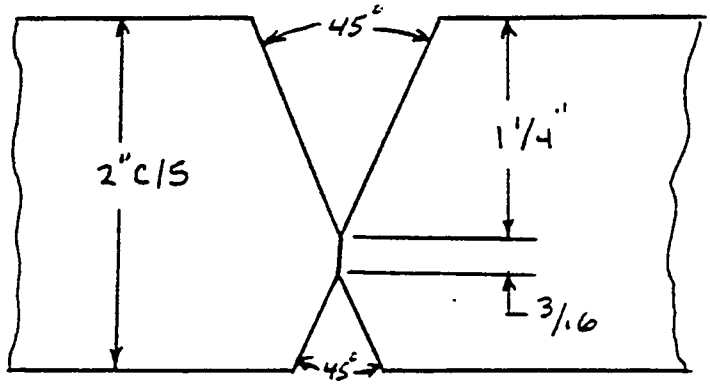
SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 780 / MIL-F2
PO/Heat/Lot P54-3-3552-R 1365

FINAL NDT: X MT ___ PT | X Satisfactory ___ Unsatisfactory
Procedure N23 Initial WJL

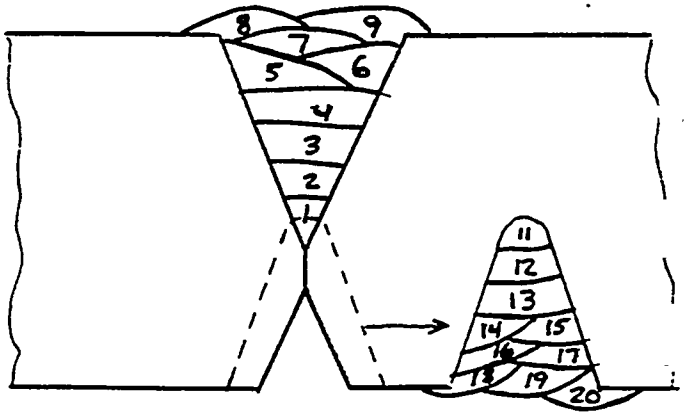
RT: X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000 CL

Comments ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 1 1/4"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-2	550	30	A	1 1/4"	21 ipm	45ipm	—	—	NO POWDER IN ROOT.
3-8	600	36	A/B	1 1/4"	20 ipm	47ipm	7.4	—	1.25:1 POWDER-TO-WIRE
9	600	36	A	1 1/4	20 ipm	47ipm	—	—	
10-11	550	30	A	1 1/4"	21 ipm	45ipm	—	—	
12-16	600	36	A/B	1 1/4"	20 ipm	47ipm	7.4	—	
17-20	600	36	A	1 1/4"	20 ipm	47ipm	—	—	

Technician/SSN	Charge	Date	Joint No.
K. R. FISHER	1026M-15	11-27-85	M729-68

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method N/A
interpass (max) N/A
measured by N/A
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN ; ___ AC ___ DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: (A) 5/32" LINDE MIL-A1 ; (B) OERLIKON EL-12
PO/Heat/Lot: P545-3574-R / 08115 ; METAL POWDER
Specification: MIL-E-18193 ; LOT 1280038

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: C/S 24"x36"x2"T
PO/Heat/Lot: H.O. 16953829
Specification: MIL-S-22698

JOINT: Type B2V.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground X Gouged ; X MT ___ PT ; X Satisfactory ___ Unsatisfactory
Procedure N23 Initial BAS

VISUAL INSPECT: ___ Ground X As welded ; X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

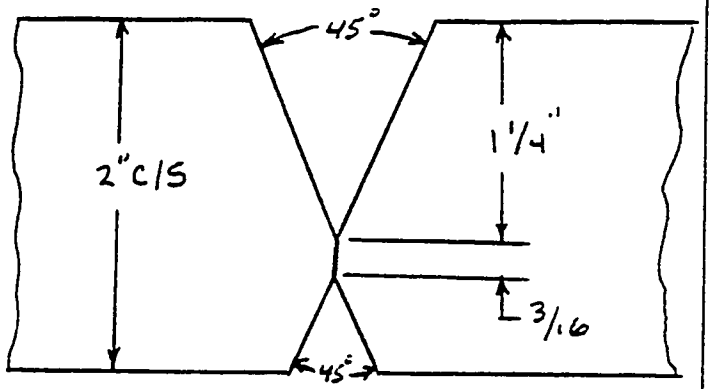
SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 780 / MIL-F2
PO/Heat/Lot PS4-3-3552-R 1385

FINAL NDT: X MT ___ PT ; X Satisfactory ___ Unsatisfactory
Procedure N23 Initial LHB

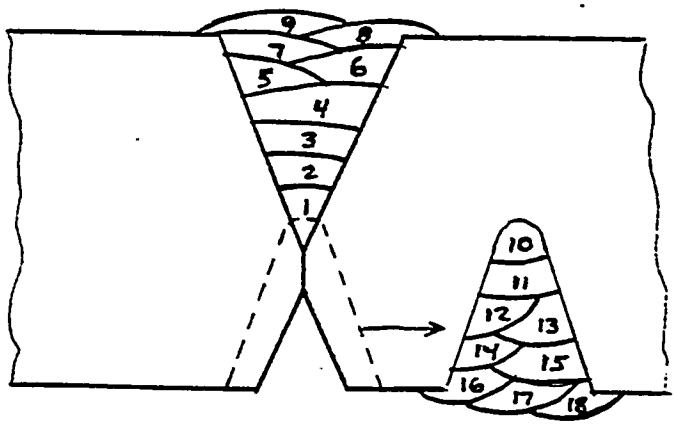
RT: X Accept ___ Reject
Radiograph to: ___ MIL-STD-271 ___ Interpret to: 0900-003-9000 CL 1

Comments ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH = 7/8"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-2	550	30	A	1 1/4"	21 ipm	45 ipm	—	—	NO POWDER IN ROOT
3-6	800	40	A/B	1 1/4"	25 ipm	64 ipm	10	—	1.25:1 POWDER-TO-WIRE
7-9	600	36	A	1 1/4"	20 ipm	N/R	—	—	
10	550	30	A	1 1/4"	21 ipm	N/R	—	—	
11-15	800	40	A/B	1 1/4"	25 ipm	65 ipm	10	—	
16-18	600	36	A	1 1/4"	20 ipm	46 ipm	—	—	

Technician/SSN	Charge	Date	Joint No.
K. R. FISHER	1026M-15	12-4-85	M729-69

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X semi-auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) N/A
method N/A
interpass (max) N/A
measured by N/A
maximum interpass reached? ___ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-3S
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 5/32" LINDE MIL-A1 Ⓑ
PO/Heat/Lot: P545-3574-R / 08115
Specification: MIL-E-18193

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: C/S 24"x36"x2"T
PO/Heat/Lot: H.O. 16953829
Specification: MIL-S-22698

JOINT: Type B2V.3 Avg Bead/Lgth 36"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground X Gouged; X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23 Initial WJL

VISUAL INSPECT: ___ Ground X As welded; X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

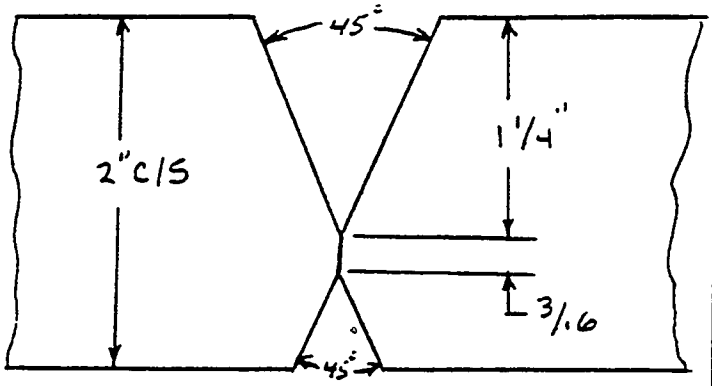
SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 780 / MIL-F2
PO/Heat/Lot P54-3-3552-R 138

FINAL NDT: X MT ___ PT; X Satisfactory ___ Unsatisfactory
Procedure N23 Initial LHB

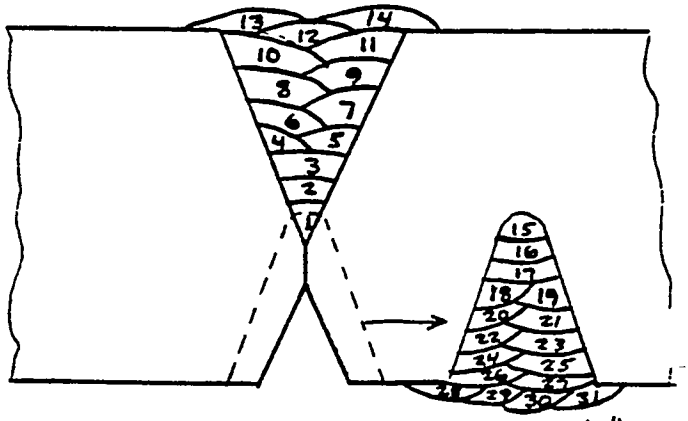
RT - X Accept ___ Reject
Radiograph to: ___ MIL-STD-271 ___ Interpret to: 0900-003-9000 CLJ

Comments ___

JOINT SKETCH



BEAD PLACEMENT



BACKGOUGE DEPTH= 15/16"

PASS NO.	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Pwdr Mtr	Pwdr Dep.	NOTES
1-2	550	30	A	1 1/4	21 ipm	45 ipm	—	—	
3-14	600	36	A	1 1/4"	20 ipm	48 ipm	—	—	
15-16	550	30	A	1 1/4"	21 ipm	45 ipm	—	—	
17-31	600	36	A	1 1/4"	20 ipm	48 ipm	—	—	

Technician/SSN	Charge	Date	Joint No.
K. R. FISHER	1026M-15	12-10-85	M729-70

LABORATORY DATA SHEET

NN 4293 (REV 2)

Newport News Shipbuilding
A Tenneco Company

PROCESS: ___ SMAW ___ GMAW X SAW ___ manual ___ GTAW ___ FCAW ___ OTHER X auto

POSITION: X 1 ___ 3 ___ 5 X G X plate ___ 2 ___ 4 ___ 6 ___ F ___ pipe

Preheat (min) 150°F
method HEATER BARS
interpass (max) 300°F
measured by TEMPSTICK
maximum interpass reached? ✓ Yes ___ No

EQUIPMENT:
Power Supply/Model: LINCOLN IDEALARC 1500
Torch/gas cup/wire feeder: LINCOLN NA-35
Current: ___ AC X DCEP ___ DCEN

FILLER MAT'L:
Size/Brand/Type: Ⓐ 1/8" LINCOLN MIL-100S-1 Ⓑ OERLIKON M2
PO/Heat/Lot: P545-3600R/147D METAL POWDER
Specification: LOT 0784020

TUNGSTEN: Type ___ Size ___ Other ___

BASE MAT'L:
Type Dimensions: HY-80 18"x24"x 1"T
PO/Heat/Lot: N/R
Specification: MIL-S-16216

JOINT: Type BIV-3 Avg Bead/Lgth 18"

TORCH ANGLE: Lead/Lag 0° Tilt 0°

BACKSIDE PREP/NDT: ___ Ground ___ Gouged ___ MT ___ PT ___ Satisfactory ___ Unsatisfactory
Procedure ___ Initial ___

VISUAL INSPECT: ___ Ground X As welded X Satisfactory ___ Unsatisfactory
Procedure ___ Initial HMR

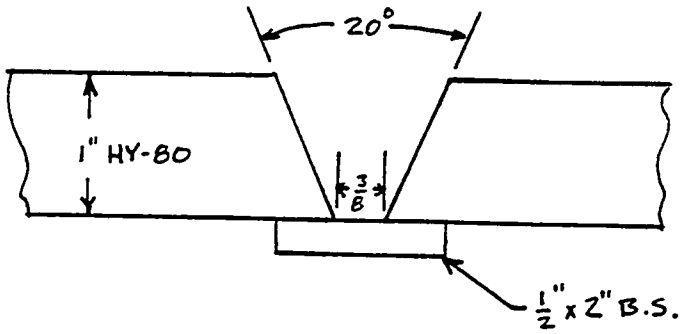
SHIELDING METHOD: Gas Mix ___ CFH
Flux LINCOLN 880M
PO/Heat/Lot ___ N/R ___

FINAL NDT: X MT ___ PT X Satisfactory ___ Unsatisfactory
Procedure N23/123 Initial LHB

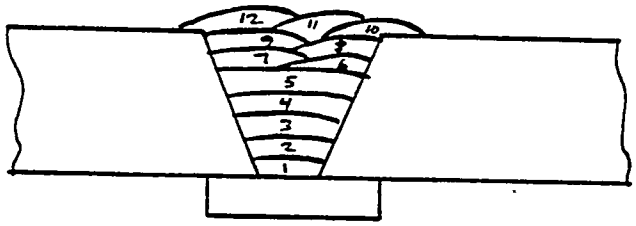
RT': X Accept ___ Reject
Radiograph to: MIL-STD-271 Interpret to: 0900-003-9000

Comments ___

JOINT SKETCH



BEAD PLACEMENT



PASS NO	AMPERAGE	VOLTS P.S. / ARC	FILLER MAT'L	ELECTRODE STICKOUT	TRAVEL SPEED	WIRE FEED SPEED	Powdr Mtr		NOTES
1	475	34	A	1 1/4"	15 ipm	N/R	—		NO POWDER IN ROOT
2	550	34	A		21 ipm		—		1.25:1 POWDER-TO-WIRE
3-5	↓	↓	A/B	↓	↓	↓	7.5		
6-12	↓	↓	A	↓	↓	↓	—		

Technician/SSN	Charge	Date	Joint No.
B.A. STINSON	1026M-15	7-11-85	M729-53

APPENDIX E

EXPLOSION TESTING RESULTS

MARE ISLAND NAVAL SHIPYARD
QUALITY ASSURANCE OFFICE
WELDING ENGINEERING DIVISION
CODE 138

Expiosion Testing of HY-80 Steel Test Assemblies Welded with the Submerged Arc Welding Process

ENGINEERING TECHNICAL REPORT
PROJECT 138-28-85
JULY 1985

AUTHOR : F. Reichstein

APPROVED BY:

HEA

HEAD, WELDING ENGINEERING DIVISION (CODE 138)

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LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Mare Island Naval Shipyard (NAVSHIPYD MARE) was funded by Newport News Shipbuilding and Drydock Company to explosion test a six plate series of weldments. The weldments were HY-80 rolled plate base material which was butt welded using the conventional single electrode submerged Arc welding process and, for some weld beads, the Submerged Arc Bulk Welding (SABW) process. The SABW process involves the use of the conventional single electrode submerged arc process with the weld deposit being supplemented by controlled composition powered metal which is added to the weld *groove* ahead of the arc and becomes a part of the weld through fusion by the arc. The powered metal addition significantly increases the weld deposition rate and therefore was not used in the root welds of the double bevel joint preparation (i.e. because of the potential for unfused metal powder inclusions in the weld deposit) and was not used in last layers of the butt weld (i.e. because of the potential for excess weld reinforcement). The six weldments were explosion tested as two crack starter plates and four bulge plates at the NAVSHIPYD MARE explosion test site during the week of 21 July 1985. The crack starter weldments met the explosion test criteria of no fractures into the hold down region and no pieces thrown out of the weldment after two explosive loadings. The bulge test weldments met the explosion test criteria with a thickness reduction of sixteen percent and no fractures into the hold down region. Because of the limited use of the bulk weld process (i.e. midway between the root and final cover or cap passes on each side of the double bevel weld) the explosion testing did not tension load the bulk welded beads to the extent experienced by the conventional submerged arc welded cover beads on the tension surface of the explosion test weldments.

PROJECT 138-28-85

I. Introduction

During the week of 7 July 1985 Mare Island Naval Shipyard (NAVSHIPYD MARE) received six HY-80 rolled plate weldments from Newport News Shipbuilding and Drydock Company (Newport News) for explosion testing. Funding to cover the costs of explosion testing was provided under Newport News Purchase Order No. POM-84025-R.

11. Welding and Mechanical Testing

A. The explosion test assembly welding was accomplished by Newport News using the submerged arc bulk welding process. Newport News provided a COPY of the weldinq data technique sheets for information.

B. Nondestructive testing of the explosion test assembly welds was accomplished by Newport News and the results reported to be acceptable.

C. Mechanical testing of the submerged arc bulk weld deposited weld metal was accomplished by Newport News and the results will be reported separately along with the welding and nondestructive testing data.

III. Weldment Explosion Test Preparation

A. The two-inch thick HY-80 test weldments, as received from Newport News, were cut to a 30-inch by 30-inch size with the weld centered on one 30-inch edge. Explosion test preparation consisted of the following:

a. Grind removal of the weld reinforcement in the explosion test die hold down area.

b. Weld deposition and notching of the crack starters on the explosion crack starter test assemblies.

c. Preparation of the explosion test weldments for thermocouple implants.

IV. Explosion Testing

A. The explosion testing was conducted at the NAVSHIPYD MARE explosion test site at the Army Ammunition Plant at Hawthorne, Nevada during the week of 21 July 1985 and was performed in accordance with NAVSHIPYD MARE Procedure 138-14-71, "'Standard Procedure for Explosion Testing and Evaluation (Weldments)" and MIL-STD-2149 (SH), "Standard Procedures for Explosion Testing Ferrous and Non-Ferrous Metallic Materials and

Weldments." The six weldments were explosion tested as two crack starter and four bulge weldments. The explosion test temperature was 0°F. TABLE I provides a progressive description of the explosion test results for each weldment. The photographs of FIGURES 1 through 6 show the condition of the weldments on completion of explosion testing.

V. Discussion

A. The explosion crack starter weldments displayed satisfactory performance after two explosion loadings. The first explosion loading caused the brittle crack starter beads to crack presenting a sharp notch to the weld and weld heat affected zone (HAZ) of the base metal. However, cracks/fractures did not propagate in either the weld or base metal. On the second explosion loading the crack starter bead(s) initiated fractures extended only a minor extent, indicating adequate fracture toughness in both the weld and base metal.

B. The explosion bulge weldments were subjected to successive explosion loadings until they reached a reduction in thickness of 16% on one or both sides of the weld. At 16% reduction in thickness at the bulge apex all four weldments displayed satisfactory performance with no fractures.

C. Review of the explosion test assembly welding technique data sheets (i.e. provided by Newport News for information) shows that the bulk welding process was used for five beads in test weldment M729-38 (i.e. explosion test weldments M729-38A and M729-38B) and four beads in test weldments M729-40 and M729-41 (i.e. explosion test weldments M729-40A, 40B, 41A and 41B) . .These beads were approximately midway between the root and the final cover or cap beads on each side of the double bevel weld. The weld cover layer and the weld layer immediately beneath the cover layer were deposited with the conventional single electrode submerged arc process. With this situation the bulk weld deposit was not subjected to the explosion crack starter sharp notch or the severe surface strain tension of the explosion bulge test.

VI. Conclusions

A. The explosion did not evaluate the Submerged Arc Bulk Weld process because of the limited number of bulk weld beads in the test weldments and their location within the thickness of the test welds.

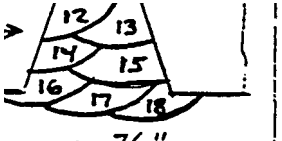
B. The test assemblies met the established explosion test acceptance criteria for HY-80 weldments.

VII. Recommendations

A. Consideration should be given to repeating the explosion test series with weldments prepared using the Submerged Arc Bulk Welding process for all or a major portion of the weld including the cover layer and the layer immediately beneath the cover layer. This would provide an explosion test evaluation of the performance of the bulk weld process.

TABLE I

EXLOSION TEST RESULTS
STAND OFF DISTANCE: 15″ TEST TEMP13RATURE: 0°F

PLATE IllENTIFICATION AND TYPE	BLAST/ SHOT NUMBER	CHARGE COMPOSITION	CHARGE WEIGHT (lbs.)	DEPT OF BULGE (INCHES) SIDE	DEPT OF BULGE (INCHES) SIDE	PLATE THICKNESS (INCHES) SIDE	PLATE THICKNESS (INCHES) SIDE	% REDUCTION IN PLATE THICKNESS SIDE	% REDUCTION IN PLATE THICKNESS SIDE	REMARKS
						2.042	2.048			Initial Plate Thickness
M 729-40B Crack Starter Parallel Beads	1.	Comp B	24	2 1/8	1 7/8	1.970	1.992	3.5	2.7	Crack Starter (CS) Beads Cracked
	2.	Comp B	24	3 7/8	3 5/8	1.774	1.833	13.1	10.5	Crack from CS Beads 1 into plate "A" side, Crack from CS Beads into plate "B" side with tip forked.
						2.060	2.049			Initial Plate Thickness
M 729-41B Crack Starter Transverse Beads	1.	Comp B	24	2 3/8	2 1/2	1.993	 DEPTH = 7/8″			
	2.	Comp B	24	3 7/8	3 7/8	1.895				

IN ROOT

DER-TO-WIRE

TABLE I

EXLOSION TEST RESULTS
STAND OFF DISTANCE: 15″ TEST TEMPERATURE: 0°F

PLATE IDENTIFICATION AND TYPE	LAST/ HOT IUMBER	CHARGE COMPOSITION	CHARGE WEIGHT (lbs.)	DEPT OF BULGE (INCHES) SIDE A	DEPT OF BULGE (INCHES) SIDE B	PLATE THICKNESS (INCHES) SIDE A	PLATE THICKNESS (INCHES) SIDE B	% REDUCTION IN PLATE THICKNESS SIDE A	% REDUCTION IN PLATE THICKNESS SIDE B	REMARKS
						2.046	2.044			Initial Plate Thickness
4 Bu1ge Plate	1.	Comp B	24	2 3/8	2 1/8	1.983	1.985	3.1	2.9 '	No Visible Defects
	2.	Comp B	24	3 3/8	3 3/8	1.928	1.925	5.8	5.8	No Visible Defects
	3.	Comp B	24	4 3/8	4 1/4	1.861	.882	9.0	7.9	No Visible Defects
	4.	Comp B	24	5 1/8	5 1/8	1.807	.808	11.7	11.5	No Visible Defects
	5.	Comp B	24	6	6	1,746	1.762	14.6	13.8	No Visible Defects
	6.	Comp B	24	6 1/8	6 1/4	1.711	1,700	16.4	16.8	No Visible Defects

TABLE I

EXLOSION TEST RESULTS
STAND OFF DISTANCE: 15″ TEST TEMPERATURE: 0°F

PLATE IDIINTIFI-CATION AND TYPE	BLAST/ SHOT NUMBER	CHARGE COMPO-SITION	CHARGE WEIGHT (lbs.)	DEPT OF BULGE (INCHES) SIDE A	DEPT OF BULGE (INCHES) SIDE B	PLATE THICKNESS (INCHES) SIDE A	PLATE THICKNESS (INCHES) SIDE B	% REDUCTION IN PLATE THICKNESS SIDE A	% REDUCTION IN PLATE THICKNESS SIDE B	REMARKS
						2.041	2.048			Initial Plate Thickness
M 729-38B	1.	Comp B	24	2	2 1/8	1.990	1.995	2.5	2 . 6	No Visible Defects
	2.	Comp B	24	3 1/4	3 3/8	1.922	1.938	5.8	5.4	No Visible Defects
	3.	Comp B	24	4 1/8	4 1/4	1.870	1.862	8.4	9.1	No Visible Defects
	4.	Comp B	24	5 1/8	5 3/8	1.785	1.789	12.5	12.6	No Visible Defects
	5.	Comp B	24 ""	5 3/4	5 7/8	1.735	1.750	15.0	14.5	No Visible Defects
	6.	Comp B	24	6 3/8	6 3/8	1.680	1.681	17.7	17.7	

TABLE I

EXLOSION TEST RESULTS
STAND OFF DISTANCE: 15" TEST TEMPERATURE: 0°F

PLATE IDENTIFICATION AND TYPE	BLAST/ SHOT NUMBER	CHARGE COMPOSITION	CHARGE WEIGHT (lbs.)	DEPT OF BULGE (INCHES) SIDE A	DEPT OF BULGE (INCHES) SIDE B	PLATE THICKNESS (INCHES) SIDE A	PLATE THICKNESS (INCHES) SIDE B	% REDUCTION IN PLATE THICKNESS SIDE A	% REDUCTION IN PLATE THICKNESS SIDE B	REMARKS
						2.036	2.038			Initial Plate Th
M 729-40A	1.	Comp B	24	2 1/8	2 1/4	1.975	1.970	3.0	3.3	No Visible Defects
	2.	B	24	3 1/2	3 1/2	1.905	1.918	6.4	5.9	No Visible Defects
	3.	Comp B	24	4 3/8	4 3/8	1.853	1.877	9.0	7.9	No Visib e Defects
	4.	Comp B	24	5 1/8	5	1.806	1.844	1.3	9.5	No Visible Defects
	5.	Comp B	24	5 7/8	5 7/8	1.768	1.788	13.2	2.3	No Visible Defec s
	6.	Comp B	24	6 3/8	6 3/8	1.698	1.73	16.6	15.1	No Visible Defects

TABLE I

EXLOSION TEST RESULTS
STAND OFF DISTANCE: 15" TEST TEMPERATURE: 0°F

PLATE IDENTIFICATION AND TYPE	BLAST/ SHOT NUMBER	CHARGE COMPOSITION	CHARGE WEIGHT (lbs.)	DEPT OF BULGE (INCHES) SIDE A	DEPT OF BULGE (INCHES) SIDE B	PLATE THICKNESS (INCHES) SIDE A	PLATE THICKNESS (INCHES) SIDE B	% REDUCTION IN PLATE THICKNESS SIDE A	% REDUCTION IN PLATE THICKNESS SIDE B	REMARKS
						2.060	2.066			Initial Plate
M729-41A	1.	Comp B	24	2 3/8	2 3/8	2.012	.994	2.3	3.5	No Visible Defects
	2.	Comp B	24	3 5/8	3 5/8	1.936	1.940	6.0	6.1	No Visible Defects
	3.	Comp B	24	4 5/8	4 1/2	1.876	.882	8.9	8.9	No Visible Defects
	4.	Comp B	24	5 /2	5 1/2	.829	1.818	11.2	2.0	No Visible Defects
	5.	Comp B	24	5 7/8	5 3/4	1.768	.781	14.2	3.8	No Visible Defec s
	6.	Comp B	24	6 3/8	6 3/8	1.725	1.712	6.3	17.1	No Visible Defects

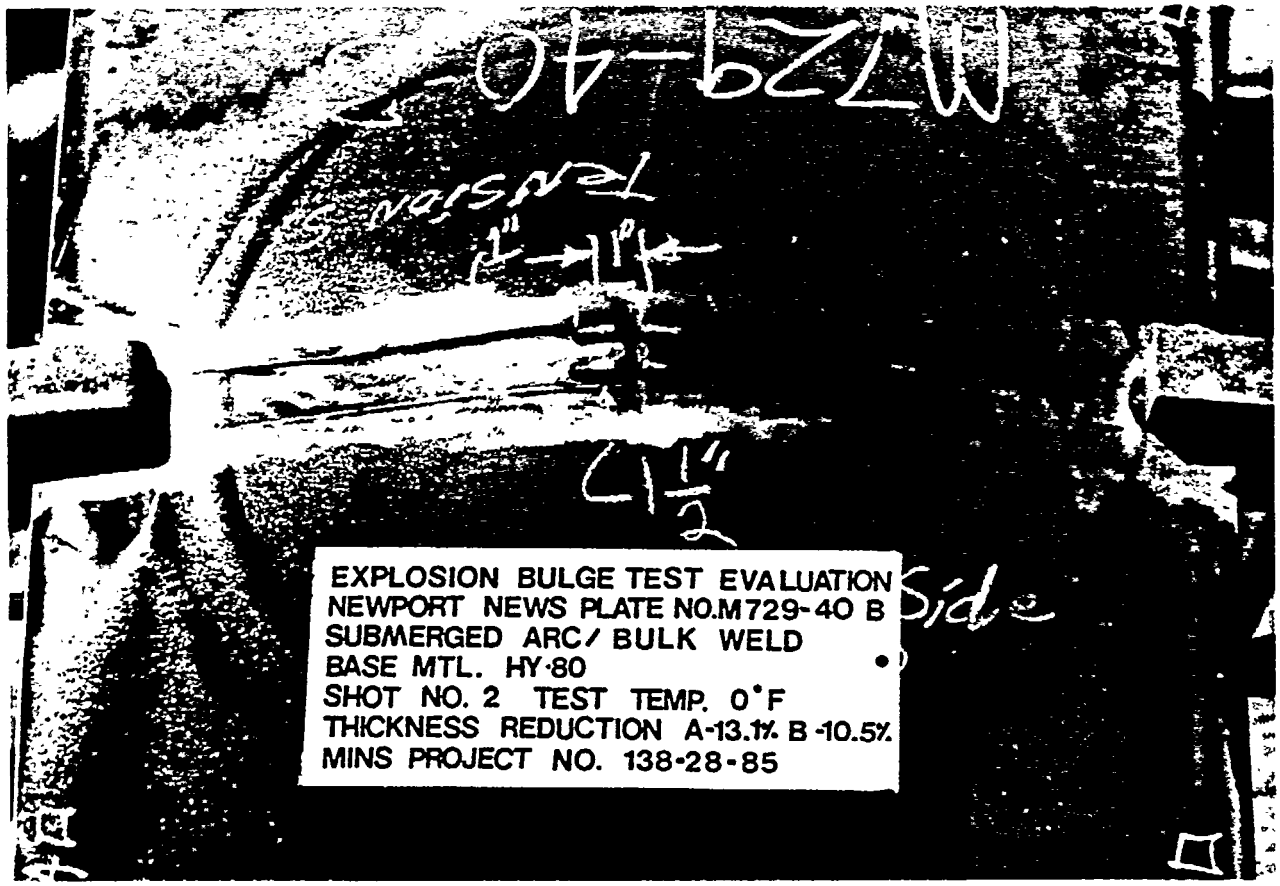


FIGURE I

PHOTOGRAPH OF EXPLOSION TESTED CRACK STARTER WELDMENT M729-40B

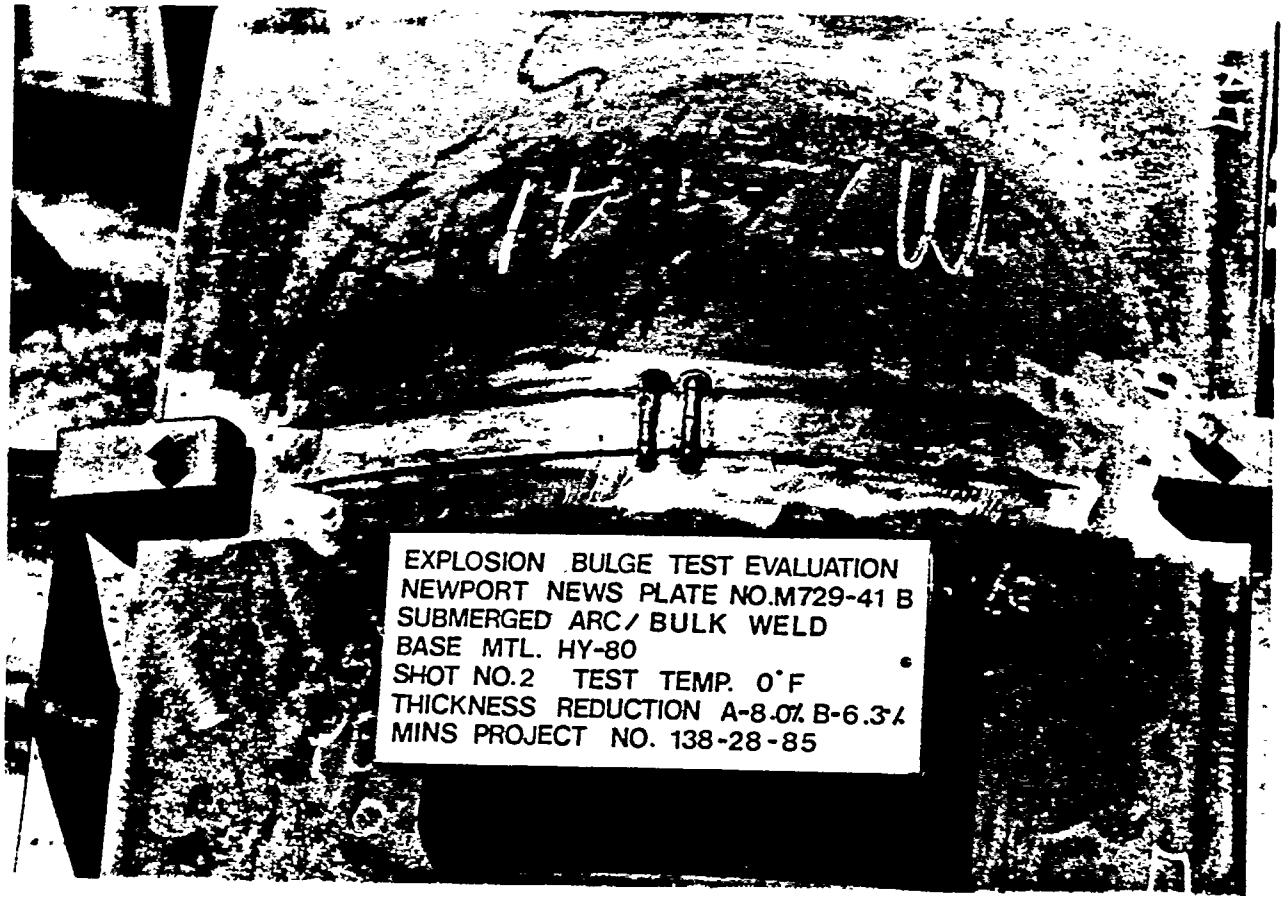


FIGURE 2
PHOTOGRAPH OF EXPLOSION TESTED CRACK STARTER WELDMENT M729-41B

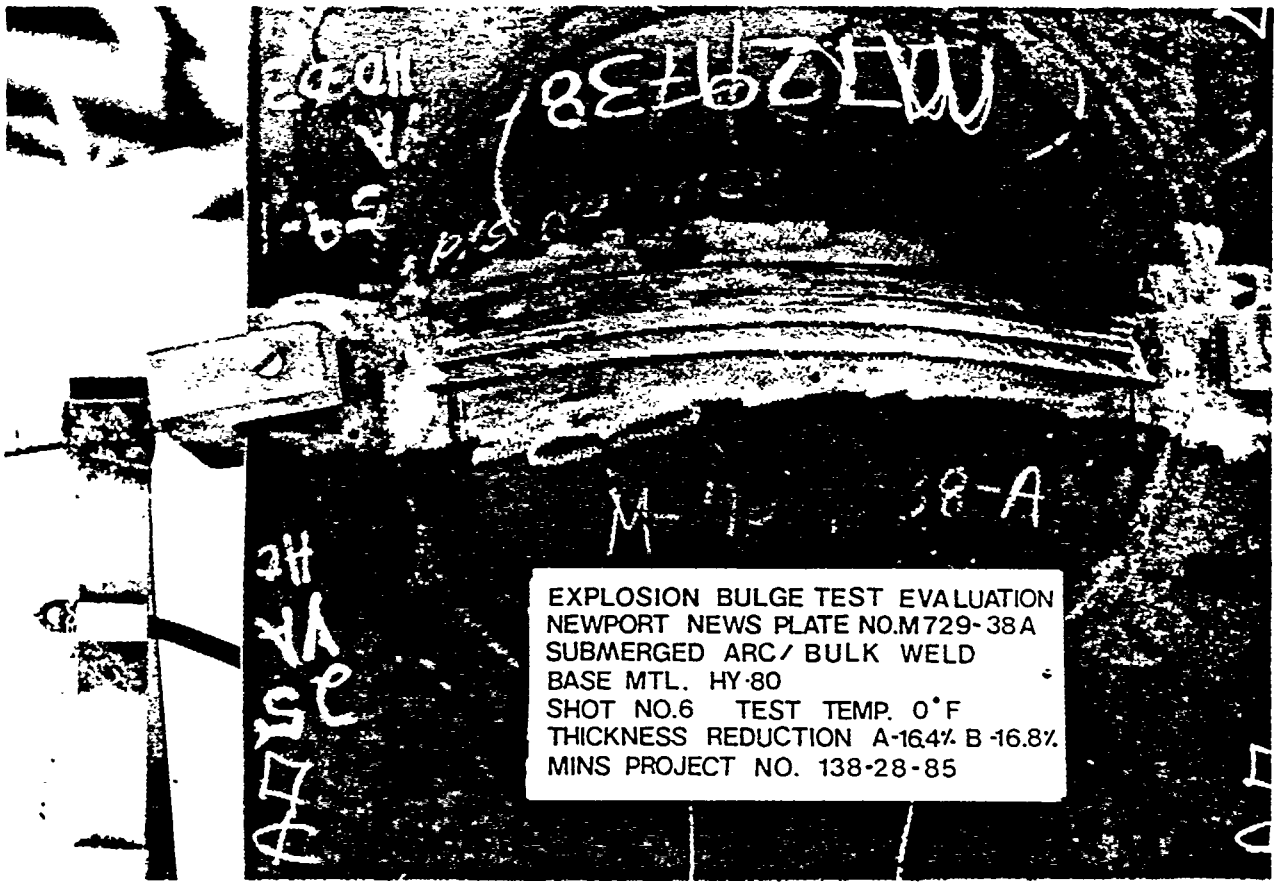


FIGURE 3
PHOTOGRAPH OF EXPLOSION BULGE TESTED WELDMENT M729-3SA

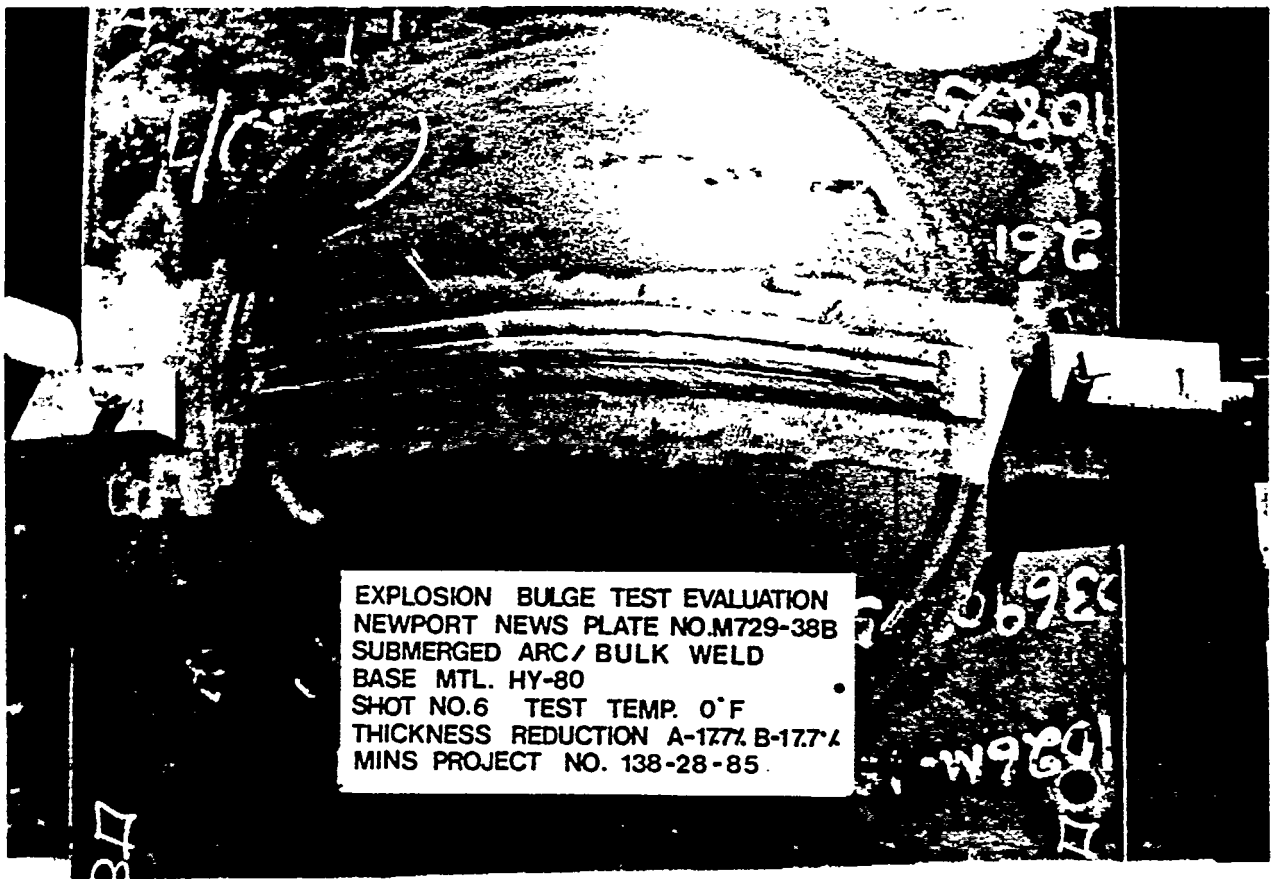


FIGURE 4
PHOTOGRAPH OF EXPLOSION BULGE TESTED WELDMENT M729-38B

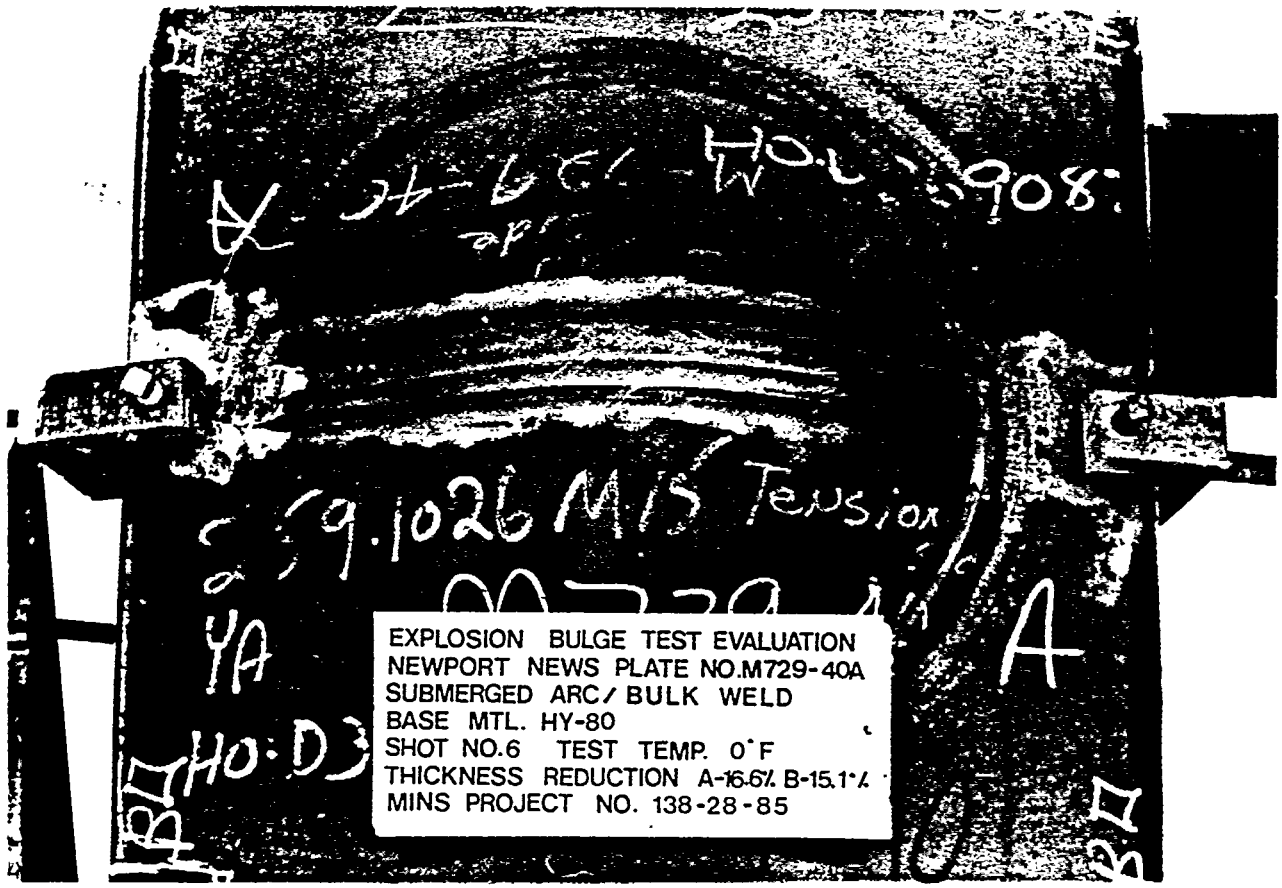


FIGURE 5
PHOTOGRAPH OF EXPLOSION BULGE TESTED WELDMENT M729-40A

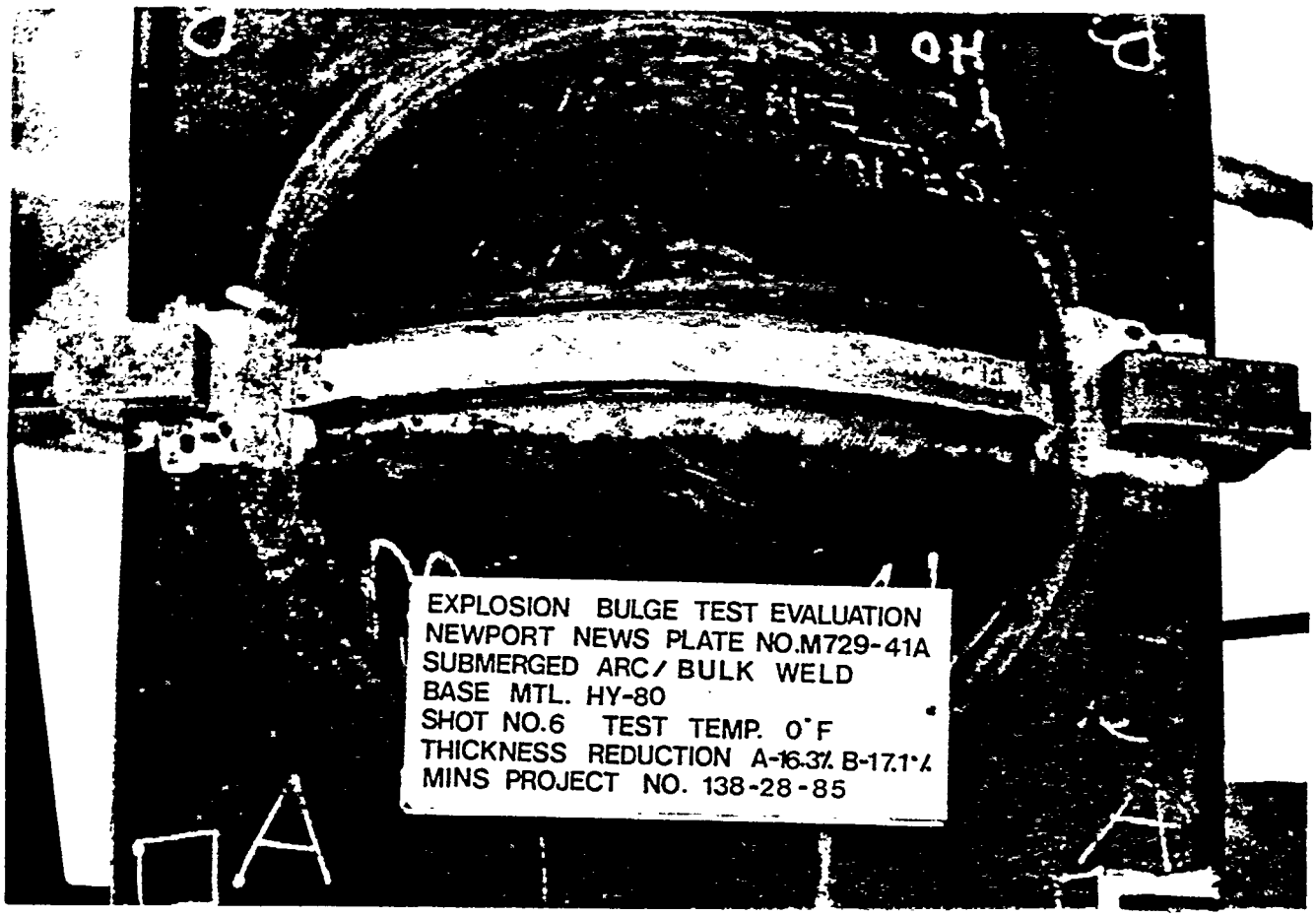


FIGURE 6
PHOTOGRAPH OF WXPLOSION BULGE TESTED WELDMENT M729-41A